SUPPLEMENT

THE INLANDER

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PROCEEDINGS OF THE MICHIGAN SCHOOLMASTERS' CLUB.

THE twenty-second meeting of the Michigan Schoolmasters' Club was held at Ann Arbor March 30–31. Both in numbers and in enthusiasm it was the most successful meeting in the history of the club. Three sessions were held, the first in the University Chapel, the remaining two in the attractive recital hall of the new building of the University School of Music, named Frieze Memorial Hall in honor of Professor Henry Simmons Frieze, first president of the University Musical Society. On Friday evening a reception was given in Frieze Memorial Hall, where the Club had the pleasure of listening to an informal musical recital by the Faculty of the University School of Music.

FIRST SESSION—CONFERENCE ON ENGLISH COMPOSITION.

The following questions were set for discussion: 1. How many compositions should be required of High School pupils? 2. How

may the burden of essay correction be lightened? 3. From what source should subjects for compositions be drawn, in the High School? 4. How may examples of bad English be used most profitably? The conference was opened by Prof. F. N. Scott, of the University, who read a paper in which he argued for the necessity of a special teacher of English composition. Commenting upon the views of Mr. Samuel Thurber, of Boston, he contended that it is unsafe, under existing conditions, to let the pupil's training in English expression depend entirely upon the coöperative efforts of teachers who are concerned primarily with other subjects than English. He did not deny the importance of this coöperation, but it was not, in his opinion, sufficient. Teachers of science, of foreign languages, etc., were not always competent to deal wisely with the matter of English expression; they were appointed with little reference to their capacity in this direction. Moreover, they had no time to devote to the systematic teaching of English expression. It was not enough to correct gross errors. The pupil had need of discipline in the principles of expression, and this required, like other subjects, a teacher specially trained for the work. The speaker then proceeded to describe the kind of training needed, in his opinion, for a good teacher of English composition, recommending especially studies in literature, studies in the history and theory of rhetoric, and original investigations in the underlying principles of expression.*

At the close of this paper, Prof. Scott read the following letters:

ON SUBJECTS FOR COMPOSITIONS.

FROM DR. SAMUEL THURBER, MASTER OF GIRLS' HIGH SCHOOL, BOSTON:

The requisites of a good essay subject are, evidently:—

1. That it be fully possessed, seen through, understood, by the writer.

2. That it be a good thing to tell about,—worth writing on, good to listen to an account of.

Essay writing presupposes a public that is genuinely to be informed by listening to the essay. Bouffe, or make-believe, essay

*The abstract of the paper is from the University Record for April. We regret that the papers of Professors Scott, Kelsey, and Hinsdale, owing to lack of room, can be presented here only in abstract. Professor Scott's paper will be printed and sent out later.—EDS. ISLANDER.

writing is where nobody wants to write, nobody wants to listen, all is moonshine, and the subject is a matter of pure indifference. It is still bouffe when the teacher inflicts a subject upon youth because the subject interests *him*,—the teacher; or when the essay is used to clinch instruction otherwise likely to get loose before some coming examination. The young writer will, like the old one, write well only when he has in view the prospect of a public to be entertained by his writing.

Thus 'literary' themes may be good. Such themes will be good if the youth have read far enough and with genuine interest. A theme that leads to scrapings and rakings among sources of information,—as these are conventionally understood,—is altogether not good. A literary theme is good if it is a report of exploration that has taxed the patience or has been rewarded with some sort of substantial find. Whatever is written must be written with earnestness and enthusiasm; and themes must be chosen with this principle in view. Literature is a good field for such explorations as girls love to make and give accounts of. But I have to labor to keep them away from imitation of the current magazine kind of criticism. This is deadly and stupefying. What a young person likes and others may be led to like by good telling of it, is a good subject. I would by no means prescribe a proportion of any one kind of subject. Nor would I have a whole class necessarily observe any rule in this matter. The very best subjects are hardly apt to be the purely literary ones: but rather those which have to do with art or with history *and* literature. E. g. *Keramos* is a splendid subject. The literary subject, as too frequently conceived, calling for judgments and verdicts, tempts into echoing a sort of 'literary' maundering, as dreary and useless as can be imagined. Writing without content, —*inhaltsloses Fortschreiben*,—producing what no one can listen to or get an idea from,—is the thing to avoid. And I should not object to any kind of subject that should help resist the blight of such writing.

FROM PROF. A. S. COOK, OF YALE UNIVERSITY:

I should reason upon the subject somewhat in this way. The subjects proposed should be (*a*) comprehensible, (*b*) stimulating, and, if possible, (*c*) suggestive of hints for guidance. All these conditions are better fulfilled by works of art than of nature. The most available art for the purpose is that of literature. Hence the subjects should be predominently drawn from literature, though of course not exclusively.

To amplify my thought a little. Good art is simpler than nature, because it is a selection from nature, organized in illustration of a sentiment or a thought. Being simpler, it is more comprehensible; being illustrative of a sentiment or a thought, it is stimulating; in so far as it is good art, it is suggestive of hints for guidance.

To illustrate. Any art will serve. It is easier to write intelligently about a musical composition than about a series of casual noises; it is easier to write about the Apollo Belvedere than about the first photographic portrait that comes to hand; about Shakespeare's Julius Cæsar than about an acquaintance or even a friend. Half the work has been done for you. The artist has shown you what he means, and at the same time provided you with a model. The principles of structure displayed in the masterpiece are yours to appropriate; the style is at once an incentive and a goal.

I should conclude, then, that compositions upon literary subjects—let me say, more generally, artistic subjects—would constitute a sort of propædeutic, preparing the aspirant for the more difficult task, the treatment of nature at first hand. This is more difficult, because in nature the ideas have first to be discerned, while in art they are already emphasized. By this I do not mean, however, that I should reserve all literary studies from nature for a later stage of the work, but that I should intersperse them among the more numerous studies from forms of art, as the pupil was able to bear them, in other words, as he gained sufficient insight into modes of treatment, and power in the perception of structural lines, to produce relatively good original work.

ON THE USE OF BAD ENGLISH.

FROM PROF. J. F. GENUNG, OF AMHERST:

I think all teachers will agree with the remark I have ventured to make in the preface to one of my books, that 'it is safer to study models of excellence than examples of error.' The kind of English with which a student's mind should be saturated, so far as this can be effected through his reading and his daily intercourse, should be the best English. We should seek as far as we possibly can to create an atmosphere of good English usage, pure, dignified, graceful, yet not stiff and pedantic; and in such atmosphere well-chosen words and correct idiom and grammar should grow unquestioned, as a matter of course. It is from such environment, more than from anything else, that the student insensibly develops a literary sense.

But in language as in everything else, the things of most evident and unquestioned excellence are not always the most striking. If taken as a matter of course, they often come with too little thought to make the student see *why* they are so. The naughty things seem the nice things—that is, often they are spicy, racy, have the tang of interest, albeit slangy and vulgar. The student must somehow come to know why the locutions he uses and hears used so spontaneously are bad. We cannot infallibly keep him from using bad English by showing him only the good. We must show hin also the bad, yet I think in such way as too keep the predominant

influence for the good always in sight, and to leave him if possible committed to the good.

For this reason, while examples of bad English must necessarily be worked with and corrected, this should not be done, it seems to me, in such a way as to make the student feel as if he were guessing puzzles or wading through the mud of inperfect expression without a clear sight of the firm land beyond. In other words, mere lists of false syntax and ill-chosen words to be corrected seem to me of very doubtful value. I should want to put the bad English in some *setting* of coherent speech or story, so that by the correcting of it there should step by step emerge a satisfactory piece of composition which should justify itself as it stands by the side of the old imperfect production. I have tried, perhaps very crudely, to embody something of what I mean in the compositions to be rewritten, in my recent Outlines of Rhetoric. By such exercise of rewriting occasion may be taken to teach not only choice of words and grammar but many more things pertaining to clearness, strength, and grace of expression; while something is all the while being done to conserve and strengthen the student's literary sense.

From Prof. G. R. Carpenter, of Columbia:

For some years I have been a warm advocate of the system which is responsible for the so-called 'Bad English' part of the entrance examination in English, as it is now prescribed at Harvard and at most of the other New England colleges. The reasons why I believed in this method of examination are briefly these. It seemed to me that we have a right to demand of a boy of sixteen or seventeen, properly fitted for college or for a technical school, first, that he should be able to write correctly and with some ease, on subjects which he already knows; and second, that he should know what is right and what is wrong in matters of grammar, syntax and the like. about which there can be no possible doubt. These two requirements are, as I understand them, respectively the bases of the two parts of our present admission examination.

The first requirement, that of ability to write with correctness and with a certain degree of ease. is not, I think, in question. The second requirement, that of correcting specimens of bad English, is certainly simple in theory. Here we test not expression, but knowledge. Rhetoric may fairly be divided into questions of taste and questions of absolute right and wrong. Drill in matters of taste we can afford to leave for the most part until the student is a freshman in college. There he can best attain skill in the exact choice of words, with all their fine shades of meaning; in deftly framing them into well-balanced sentences; in coherent and logical structure, both of paragraphs and of the larger unities of composition; in short, in all that sound and nice thinking out into language which makes a man write clearly, forcibly, and pleasantly.

There is much in writing, however, which is not a question of taste but of knowledge: and that knowledge a student should have when he presents himself for the admission examination. He should spell correctly; he should be familiar with the principles of punctuation, and with the forms of inflection and conjugation; he should know the difference between *shall* and *will*; and in general he should be exactly informed about plain questions of syntax and idiom about which there can be no doubt. As long as boys write so incorrectly on their examination papers as we all know that they do, the examiner must find some means of testing their knowledge point blank. There is no great reason why he should not do this by printing a dozen or so sentences, in each of which there are palpable errors, and asking the candidate to correct them. If he cannot detect common errors when they are so isolated as to provoke discovery, it is not likely that he will be successful in expelling the same or similar errors from his own composition.

I have always felt, however, that this system laid us open to peculiar dangers, which I called attention to in a preface which I wrote two years ago, for a new edition of Strang's 'Exercises in English,'—a book specially designed for drill in preparation for this part of the English examination. What I said was this: 'A teacher must not forget that this homœopathic device of producing good English by the use of bad is open to great and real dangers. Pupils may sometimes need but very little drill of this sort. More would impress on their memories wrong forms or unidiomatic constructions, rather than proper forms and idiomatic constructions. Rarely will the pupil need to go through the entire book. The teacher's judgment must tell him where to stop; but he would be guided by remembering that such drill must always be subordinated to that of actual composition. The pupil must be taught, not only to know bad English when he sees it, but to write good English.'

Recently, moreover, a study of some of the papers in 'Bad English' which have been set at some of our leading colleges has convinced me that one may easily go too far in such a system. It is not fair to ask a boy catch questions—not fair to ask him in a few hurried minutes to detect and correct errors in a sentence which is bad from beginning to end, and over which wiser heads than he might long puzzle without being able satisfactorily to remodel it. I notice, too, that boys who pass this part of the paper with credit sometimes make the very same blunders in the composition part of the paper which they have corrected in the other part of the paper; and that it is perfectly possible for a boy to write as well as one can reasonably expect him to, and still not be able readily to detect and to correct blunders of the sort that are usually put upon papers of this kind.

My idea is now that it would be better to confine the bad English part of the paper to half an hour, or relatively speaking, to the

value of about fifteen per cent. of the entire paper; and that the questions asked should be of such a sort as to show the candidate's knowledge of grammar and syntax, not his knowledge of rhetoric or of the finer points of English idiom. In short, I should be strongly in favor of greatly simplifying this part of the examination,—reducing it, say, to the correction of merely four or five sentences,—and of combining it with an examination in formal grammar.

From Prof. A. S. Hill, of Harvard:

You will notice that in the "Foundations of Rhetoric" as I say in the preface, I begin the examination of every question with at least one example—"a practice which enables the student to discover for himself the rule under which the example falls. For young scholars this is the true order, for it is the order in which the mind naturally works. In experience, facts come before principles or rules; induction precedes deduction."

In giving instruction in rhetoric I should follow the method employed in the book,—that is, I should begin the discussion of every question with an example, and should make the pupils understand why one form is correct and the other incorrect, and thus help them to discover the underlying principle, and teach them, in Mr. Buehler's language, to "put the emphasis on the principle." In every case I should insist on their applying their memories, not to the particular example, but to the principle which it illustrates.

The next step would be to apply the principle thus clearly understood to fresh examples—the additional ones in the book, if any, and others drawn from such sources as may be accessible to the teacher. Such examples might be taken from themes, from oral recitations, from written exercises on any subject connected with studies other than English. If the teacher were to have a little blank book in his pocket in which to jot down such examples as he may come upon in his reading or conversation,—as I do,—he would find it of assistance. Pupils might be encouraged to bring in examples of incorrect English heard in lectures or conversation, or met with in reading.

They might also be encouraged to bring in examples of good English; for in those parts of the book which deal with the excellences of style, I have found it impossible to do more, within the prescribed space, than point out certain directions in which the teacher may profitably work. In the pages entitled "Words to Choose," for example, I have room for only a few illustrations of the advantages and disadvantages of long or short, general or specific, literal or figurative, expressions; but a teacher may add indefinitely to the supply, or—still better—may encourage his pupils to make additions themselves from the books they are reading, whether in the school room or out of it. A similar remark may be made

concerning the pages on "Sentences to Choose," on "Antithesis" and "Climax," and on "Paragraphs."

In the matter of applying the principles when once mastered, the greater the variety of method the better. One method might well be to put on the blackboard a sentence of bad English, and then make the pupils correct it. As the questions grow in complexity, there will be, I think, a good many variations in results, and some of the pupils' translations of bad English into good will be quite as satisfactory as those in the book, but different from them. The miscellaneous examples (pages 162–170) might be used in this way without previous study. They contain faults similar to those which are discussed in the preceding pages, and there are often two or three faults in one sentence.

After my pupils had mastered the book, I should wish them to keep it as a book of reference. Whenever I noted in a composition or in a written exercise of any kind, a fault of which examples are given in the book, I should call the scholar's attention to the point, and should make him see that his fault was the same as that discussed in the book. I should use this method, not only with the individual writer who had committed the blunder in question, but with the class also, either by orally calling attention to the blunder, or by putting it on the blackboard. I should think that a good exercise might occasionally be made by reading to the class the faults in a set of compositions (before the compositions were returned) and having the pupils correct these faults orally. In such an exercise, I should require the pupils to give a reason for the correction and to refer the fault to the head under which it is treated in the book.

The most important suggestion is, I think, that of combining the study of the book with the actual work of the student in composition. No text-book, however, good in itself, can be of much service unless the student is made to feel its connection with what he himself is doing in composition. In the millenial period, when every sentence of written English, whether translation or statement of a mathematical problem, or exercise in history or in science,—shall be examined as English, a text-book of the right sort will be used as a means of emphasizing every criticism made by the instructor.

These suggestions cover in a rough way what I have to say on the subject. I am sure that I should be in a much better position to give hints to teachers of the book if I had taught it myself; for I never teach any book without varying my methods from day to day, and making new discoveries of ways and means. I have not much confidence in what are called *methods* of instruction, because I think that a poor teacher with a good method is infinitely less useful than a good teacher with a poor method, and that the essence of any method worthy of the name, lies in the adaptation of it to the indi-

vidual person or class taught. The good teacher feels his way with his pupils, and is quick to find that what serves with one set of boys or girls does not serve with another. Nevertheless, I believe that the less cut-and-dried the method, the more successful it is likely to be.

If a pupil never encountered any bad English except such as he himself wrote, he would be much better off than he is at present. The teacher's business is not to familiarize him with more bad English than he already knows, but to extirpate faults from his speech and his writing.

CORRECTION OF ESSAYS.

From Prof. Barrett Wendell, of Harvard:

Had I any direct knowledge of High School work, I could answer your question with some semblance of assurance if not of authority. Unhappily my experience as a teacher has been wholly in Harvard College. All I know for certain, of the matter, then, is that students come to us very ill-trained in English, whence the natural inference would be that the work in the schools should not lightened for anybody, but rather increased.

It is surely unfair, though, to assume that such a question as you are to discuss is put by people who wish to shirk. Speaking very generally, then, I should suppose that the trouble might be rather a misdirection of work than a lack of it. The problem before any teacher of English—high or low—is how to make pupils write correctly, then agreeably, then with point. This generally proper order of training seems to me very imperfectly understood. From various school teachers I receive now and then inquiries which seem to show surprising confusion. They ask which of two equally proper expressions is right—a matter that is obviously either a question of taste or of the more refined kind of meaning with which school children had better not be bothered. They ask grammatical conundrums of no earthly value or meaning except to highly trained specialists. Sometimes they sin against English and good sense alike by requesting me to 'diagram' a sentence for them.

The first thing, then, is to get a teacher competent enough to understand the real limits and scope of his task. And, as I have indicated, I think the task should begin with rigid insistance on technical correctness. English grammar is a matter chiefly of good sense. In elementary schools, every pupil should be capable of learning not to make grammatical mistakes, and not to use words that have not been accepted in the language.

This done, the pupil in the higher schools should be taught, I think, first to write as specifically as he possibly can; then to write, if possible, without boring his readers; the higher rhetorical training—in matters of taste, grace, polish,—should come last.

Of course these things are not rigidly separable. By carefully emphasizing one in one stage of education and the next later, much

time might be saved, I think. Last year I had occasion to examine sixty or seventy essays by students in a large preparatory school near here. In them, I found that the elementary faults were more apt to persist than they need be. And this seemed to me due to an effort of the teachers to introduce rhetorical considerations with criticism at a time when purely grammatical might have been effectively dealt with once for all. System, then, may lighten the work in question.

In the higher classes, but only in the higher, a device useful in colleges may conceivably be of value. This is the distribution among a class of its own work, to be criticised in writing. Thus each pupil who hands in an essay takes the essay of some class mate and applies to it on the spot—actually in the class room—the principles which he has tried to make his own essay illustrate. Very often, college students do this work so well as materially to lighten the work of a college teacher. In the process, too, they learn their principles a good deal more firmly than they realize. Some such system might, with proper modifications, and great discretion, be economical in schools.

In general, though, I find myself believing more and more in brains rather than in methods. The reason that pupils are ill-taught is rather that teachers are stupid, pedantic, ill-trained than that they don't try to do their best. And, as in every other variety of human conduct, the real solution of the difficulty seems to me as despairingly simple as this: let teachers apply active intelligence to the task in hand. If they do, they will accomplish the task as economically as each is able to. Nothing can make it anything but irksome. Nothing but eager faith in its value can sustain whoever undertakes it.

The discussion was opened by Prof. F. A. Barbour, of the State Normal.

PROF. BARBOUR:

I must beg the pardon of the Club for not talking to the printed questions upon the programme. I am so heartily in sympathy with Mr. Samuel Thurber in his views upon teaching English, that I cannot forbear speaking a few words in his defense. It would be a pleasure to us all, I am sure, were he here to speak for himself in his own clear and vigorous style. His thought is, as I have gathered it from his published articles, and from conversation, that the most effective remedy for poor English in the schools, is the hearty co-operation of *all* teachers to secure good English. This co-operation of the teachers of different subjects of study, in their requirement of correct English, he conceives to be more important than the appointment of a special teacher of English Composition.

The danger in the appointment of a special teacher is, that instructors in other subjects feel themselves freed from all responsi-

bility. 'There is a teacher of English Composition,' say they, 'he alone is to correct mistakes in English in the manuscripts that come into his hands ; he alone is responsible for the inability of students to use their mother-tongue with anything like ease or grace of expression.' It is this attitude of mind on the part of teachers of other subjects than English that Mr. Thurber deprecates. His position is definitely and clearly stated in the report of the 'Committee on Secondary School Studies' (p. 87).

And this view of the case, I wish to emphasize with no uncertain sound. If there is a teacher of Physics in the State of Michigan, such as Professor Scott has described, the first duty of his Board of Education is to dispense with his services! I see in my mind's eye a model High School. Its students pass into the 'laboratory of English Composition', and are trained for an hour in the use of clear and correct English ; they cross the hall to the laboratory of Physics or Chemistry, and spend their next hour with an instructor who cannot tell whether their English is good or bad, who is himself a living example of incorrect speech, and who cannot write a page of respectable English without the aid of his sister!

No, I must add my protest to Mr. Thurber's against the idea that any *one teacher* in the high school corps of assistants is to be held responsible in any special sense for the correct use of English on the part of its students.

It should be remembered in this connection that in all probability no teachers in the country have done more toward securing accurate and precise English, English that says just what it means without useless ornamentation, than these very teachers of the Physical and Natural Sciences. Indeed, for the student given to bombastic and many worded elaboration of his thought, I do not know of a better course of reading than the plain spoken style of such Scientists as Faraday, Tyndall, and Darwin.

But granting that a special teacher of English Composition would meet a long-felt want of our high schools, I cannot agree with the suggestions of the paper as to the best preparation for such special work. I would not have the teacher of English Composition devoting himself exclusively to the study of the rhetorical art, or carrying on original investigation in search of underlying rhetorical principles. Such a teacher, in my judgment, would be likely to commit two serious mistakes. First, were he not constantly upon his guard, he would teach over the heads of high school boys and girls; and secondly, he would be in danger of making composition stilted, mechanical, unnatural. What I wish to express just here is my profound conviction that the study of language *per se*, and continued attention to formulated rhetorical rules, do not contribute directly and effectively toward the formation of an excellent English style. The rhetorician in his effort to conform to rules,

and in his constant teaching of underlying principles, is in danger of losing his sense for style.

An interesting letter has just been read from Professor Genung. I know of no better presentation of the subject of Rhetoric than his 'Practical Elements' and his 'Rhetorical Analysis.' Indeed, I am hoping to find his 'Outlines of Rhetoric' the best elementary work that has yet appeared; but even Professor Genung seems to me not infrequently to have fallen into the grave error of weakening correct, forcible, and idiomatic English, by changing it to conform to so-called rhetorical rules. Observe, for instance, the unfortunate correction of the sentence on page 298 of his Practical Rhetoric: 'Yet he did know that "Christ and him crucified" was now his all in all: and this knowledge thrilled every fibre of his body.' 'The sentence ought to be recast', says Professor Genung, so that faithfulness and grammatical structure should coincide: 'Yet he did know that his all in all was summed up in "Christ and him crucified"; and this knowledge thrilled every fibre of his body.' The first sentence has force, strength, vigor of style; as corrected it is robbed of its style. One can well understand what Daniel Webster meant when he said 'that the *Ars Rhetorica*, as taught in the college, came very near ruining his style.'

English Composition and the Rhetoric of our high schools should be taught very largely in connection with literature. While the student's mind is aglow with enthusiasm over some noble passage in his reading, he is in just the mood to give the most effective, the most literary expression to his own thought. And let his instructor, also, relieve the drudgery of correcting manuscript by frequently refreshing his mind with wide and varied reading in the best literature. Were I to mention, indeed, three essential qualifications of the teacher of English Composition, they would be: First, an intelligent and appreciative enjoyment of the best literature, prose and poetry; secondly, the ability to express his own thoughts in clear, effective, and graceful English; and lastly, almost a divine love for the boys and girls under his charge,—a love which should find its reward in *their* increasing power of thought and expression, a love which should cheer many a weary hour with the thought, 'This is monotony, indeed, for me; but it shall bear rich fruitage in the minds of the youth whom I serve.'

SUPT. E. C. THOMPSON, OF WEST SAGINAW H. S.:

I am placed somewhat at a disadvantage by the turn the discussion and paper has taken, it is so different from what I had supposed it would be. And I am still more unfortunate in that until a very few minutes ago I had no opportunity of knowing what the drift of the discussion was to be. I do not know that I ought to speak upon this question, I am so thoroughly out of sympathy with the paper itself. I do not know what I could do with a special

teacher of English composition, were one let loose in my high school. I think I should try to inspire him, and then I should want him to inspire all my teachers to do thorough work in English. In this way only could I succeed in making the best possible use of him. I believe in inspiration. We often hear it said, especially in associations like this, that it is impossible to teach what we do not know. I do not believe that. I believe it is possible for the true teacher to inspire his pupils to do things that he cannot do himself: if he has not this power he cannot develop in his pupils the best that is in them. We expect many of the boys and girls who come to us to have greater minds than we have; in the days to come we expect them to outstrip us in life; we expect they will do things we could not do, even if we exerted ourselves to the utmost. If we can be the means of inspiring them to their best effort, it seems to me we have done our work.

I have been much interested in the little blind and deaf girl, Helen Kellar. She has been a study to me; she has been an inspiration to me. I never think of her but I feel that I ought to do and be more; that I ought to develop to a greater extent the powers God has given me. I have jotted down a few of her thoughts. (Reads several quotations.) I have wondered where she obtained these beautiful thoughts. Are they due to her wonderful qualities of mind and heart, the God-given powers that she possesses, or are they in a measure the result of the teaching she has received? I believe one great secret of her ability is that everything has been carefully prepared for her; ideas are not given her so rapidly but that she may think them over, until she has made them a part of herself, and woven them into every possible form. Another secret of the power of this wonderful girl, it seems to me, lies in the fact that she has had only the purest, the strongest, the best presented to her. I believe if we could follow the example of her teacher—and she has not had special teachers for the separate branches, as I understand it—if we could fill our children's minds with the strongest, the purest, the best in literature, we would have very little difficulty in the matter of English composition. Associated with literature is science and art; intimately connected with English and very helpful is French and German. Out of this literature would come a rich fund of thought, which would become the child's own, and which the child would use in English composition. I think this work should begin before the child is sent to school; it should be followed up in the kindergarten, through the primary and grammar grades; then, by the time the child has reached the high school, he is prepared to do fairly good work in English composition.

Life is too short to be spent correcting 'bad English' in the school-room. Helen Kellar hears no 'bad English' hence her language is largely book language, and, for that reason may be subject to criticism on the part of some. But I believe in it. I believe

in reading to children stories written in the best language, reading them over and over; in telling stories to children in the best possible language--book language if you choose; then let the children tell those stories back again, using the best language they are capable of using—it may be the language of memory—during the early years it may come almost entirely from remembering what the teacher has said—let the children learn to talk on their feet, and they will soon gain confidence in themselves and tell the stories well; let the children repeat the stories until they are filled with the thoughts contained in them. By and by have the children write them. You will see gradually creeping into them the children's own thoughts and language. Now they begin to do a little, a very little in the direction of originality. But this grows as the children grow, and by and by they will write very creditable English. The first thought then, is to enrich the children's minds, fill them with the very best in literature. Where did Milton get his idea of Paradise Lost? From a poem written many years before. Where did Dante get his ideas? From Virgil. Where Virgil his? From Homer. Where Homer his? Why he gathered them from the stories and myths of the past, which had been handed down from generation to generation.

QUESTION:—You would not have examples of 'bad English' brought into the class-room?

SUPT. THOMPSON:—No. I would not. My idea with regard to the use of literature, is to make it the basis of study in other lines. It is very easy to lead the child's mind from literature to science. For instance, the study of the story of Cupid and Psyche leads very naturally and beautifully to the study of the butterfly, and on to deeper subjects of life, death and immortality.

QUESTION:—How about the number of compositions to be handed in?

MR. THOMPSON:—Not more than one or two formal compositions. But I would have those compositions corrected and recorrected until they were the pupil's best efforts.

DR. W. COOK, OF THE DETROIT HIGH SCHOOL:

Just as we teachers have come to realize that in our school work we are attempting too much, that we are dealing with too many subjects, it seems strange that anyone should propose that we have a special teacher for English work. But I wish to take but a few minutes in which to talk about this subject, and I shall make no attempt to show what seems to me perfectly clear—that such a view of the English work is entirely wrong. I suppose we are discussing the paper.

I want to illustrate what the true relation of English work is. Every pupil comes into the school with some sort of English which he uses in one way or another: this English is that used about him;

he is born into certain conditions of English, so to speak, which he reproduces in his own life. If in the school-room he hears new words, different pronunciations and grammatical constructions, he unconsciously adopts them. If we are to undertake to conduct the work on a true principle we must make use of that principle illustrated by the child when he comes into the school. We must place before him a model, and we must try to make that just as natural and unconscious to him as the one he first used. A child does not use the language that his fathers have used, and not another, because he is conscious of the effort to imitate them ; he does it without thinking of it. We should try to put into his mind something that he will use in the same unconscious way. How is this to be done. Our spoken English, ordinarily, is not model English, it is not the kind of English we write. We have any quantity of good English in the best literature. We need to take the pupil and steep him in the best literature, as it were. Matthew Arnold, a few years ago, said that we ought to have our children in the schools learn a great deal of the very finest kind of poetry, that we may create in them the feeling for *poetry*. What we want is to give our pupils a great deal of literature, not simply poetry but prose as well, of the very finest kind— have them commit it ; work it over in every detail until it is a part of them— that we may create in them an appreciation of good literature, or in Matthew Arnold's words, the *feeling for literature*. They will then have that model which they can unconsciously apply on all occasions. Such a plan would cover a great deal of the work now given to formal composition, and this view I think answers pretty nearly all of the four questions asked; especially does it answer the question about the papers to correct and the amount of drudgery involved for the teacher of English. Grammatical construction will take care of itself, as will all the detail work of that kind.

PRIN. E. C. GODDARD, OF THE EAST SAGINAW H. S :

This subject of English composition is a new one, so new that the teaching of English is in a most chaotic state; perhaps this might have been said with more truth a few years ago, but it is true to-day. Moreover, the difficulties presented in teaching this branch are great and have caused frequent agitation among schoolmen, which I sincerely hope may result in working out something definite.

What shall we do with incorrect English ? Suppose you are to make a study of the physical manhood, or possibilities of manhood of a class of young people. What will you correct in your pupils ? If you are the ideal teacher, you ought to cultivate in them a sound body. But what are you going to correct ? Will you say, 'Don't let your feet toe in', when there is no tendency in that direction ? You will correct what needs correction. You will point out the mis-

takes of their physical bearing, which they actually make. So in English teaching errors need correction, *but they should be the errors actually made by the pupils.* If all our pupils could be Helen Kellars, could have the same purity of life and pleasant surroundings; if we could give them all ideal teachers and fathers and mothers, who could devote their whole time to them so that they might never hear mistakes, so that when they wrote it would be without errors—then could we banish errors from the text-books. But we do not have such conditions in our city, and I doubt if they do on the other side of our river, where my distinguished predecessor in the discussion lives. Our pupils ordinarily when they come to our schools present errors enough, so that we do not need a text-book with page after page of manufactured errors to be corrected. We should gather for the teacher of English,—*for I would have a teacher of English,*—the errors naturally made by our pupils in the classes in mathematics, physics, Latin or French, as the basis of her work in correction of errors. But I would not present a lot of mistakes that the pupils would otherwise never see or hear; nor would I give them examples of fairly good English to see if they could find errors, when possibly in that effort they would make still greater ones. Such a practice may confuse and cultivate error. I know I have habitually spelled a certain word correctly, until some one questioned its spelling, and ever since that fatal day I have not been able to feel certain of that word without looking it up in the dictionary.

In regard to having a teacher of English. I do believe in it, as I said before. We need to have such a teacher that we may engender in the school a respect for the subject. Pupils are apt to think that what is everybody's business to teach is nobody's business to practice. If some one who has had the proper training is selected for this work, it will tend to magnify respect for that particular branch of study. I have little sympathy with trying to reach in practice an ideal that we can never attain to, viz: having all our teachers models in the use and *teaching* of English. I know of no corps of teachers that I would rather work with than that in the school which I have in charge. Yet none of them I think, would consider it true were I to state that they each and all were or could be the best teachers of English composition. When the pupil enters upon the high school work is just when he specially needs formal instruction and drill in the principles that underlie correct speaking and writing, that he may have a good foundation for future English work. This work should be done by a special teacher that the pupil may feel it is his business to learn it in the right way, that he may have an appreciation of what he is to do later. I do not believe this course should be very long, - including nothing but the essentials- some of the elements of grammar and rhetoric. Some of this formal instruction should be given in the ninth, some in the

tenth and some in the eleventh grade; but the important thing is that the instruction be given by a special teacher, so that pupils may feel that this work is on a par with anything in their course. And I would have this work accompanied throughout the course by a study of the best literature, that by constant association with our best authors the pupils may become familiar with the purest English and so absorb good usage. Finally, I do not believe the same amount of discipline can be secured from work in English as from that in other studies. We ought not to use it for that purpose. It is like training pupils to breathe. English is something the pupil is using constantly and is so easy and natural that it is impossible to obtain from it the strong discipline that we get from mathematics for instance. *The important thing is that the study of English be made interesting, a delight to the pupil.* With a conscientious, enthusiastic teacher in charge this could be done. Without it work in English composition and literature is usually drudgery and a failure.

PROF. BARBOUR:—We all know that what is everybody's business is nobody's business, but is there not danger that what is one person's business to teach may be shouldered on that person and the other teachers not do much in that line? I speak of this because the plan was tried at Jackson and was a failure because of this lack of concurrence between the special teacher and the other teachers. Another point: It seems to me that formal grammar and rhetoric, so far as secondary schools are concerned, can best be taught from literature.

PRIN. GODDARD:—Concerning the first point raised by Mr. Barbour, I think it depends on the principal or superintendent whether such a state of affairs is allowed. He can see to it that the work of the composition teacher is well done; so far as the other teachers are concerned the same care that the Principal must give to having all the teachers teach English would secure from the other teachers a proper care and interest in furthering the work of the special teacher in English by insisting on good English in their classes. As to Mr. Barbour's second point, I tried to express my idea clearly—that all work in composition should be accompanied and illustrated by the use of the best literature.

QUESTION:—Would you dispense with the text-book entirely?

PROF. BARBOUR:—I would dispense with about two-thirds of the matter contained in it. Perhaps it could be dispensed with altogether if you had the right kind of teacher, but it is hardly safe to recommend that at present.

PROF. SCOTT:—The failure at the Jackson schools was in the grades, was it not?

PROF. BARBOUR:—It was on the West Side, where they carry gammar work into the first year in the High School.

PROF. SCOTT :—Our discussion has to do with high school work; hence this failure has no pertinency.

PRIN. WRIGHT, OF THE JACKSON HIGH SCHOOL :

I think we are apt to run mad on this question. We are told we ought to have one special teacher; that we ought to have no special teacher, but that all ought to be special teachers. I see no objection either practically or theoretically to combining the two ideas. We have in the Jackson High School three teachers who do a considerable amount of work in English. One of these also has a large amount of work in French and German. I would not hesitate to turn over to her all of the work in English, feeling that she would be thoroughly competent to undertake it. The same may be said of the teacher of history and of the teacher of geometry.

At present I think we cannot afford to dispense with the text-book. It is well enough to do so in theory, but we must not forget that those who study rhetoric are children. Very few are above sixteen years of age, and many come into the High School as early as thirteen. Up to this time they have been tied down to a text-book, and we cannot expect rules and principles to become firmly fixed without its use. I very much doubt if the scholar's mind can be so well impressed as by having a text-book from which he can study before class; the principles and rules therein laid down can be illustrated and emphasized after he gets there. I recall my own experience, Principles which I learned in this way, some of them even after I entered college, have remained at my right hand ever since.

I think a great deal of practical benefit is to be derived from introducing specimens of bad English. While holding up beautiful models, point out in contrast some execrable models and bid the pupil beware. It often happens when the pupil is writing rapidly, that he loses the thread of thought, the grammatical relation of one word to another. The experience he has had in correcting examples of bad English from text-books or other sources enables him to go back and correct his own errors.

In our ninth grade—the first year in the High School—we do a great deal of work in this line with the drill book. The first term we give the pupils certain rules to learn, and a great deal of practice in writing compositions in class as rapidly as possible. Topics are assigned,—sometimes these are not known to them beforehand, - that are well suited to their capacity and upon which they can write without stopping to think too long. These compositions are corrected, so far as possible, by the scholars themselves in class. A pupil is called upon to read what he has written; the errors are pointed out by other members of the class. In this way the whole class are benefited. This same course is pursued in the second term when formal rhetoric is studied. In this grade we give considerable

practice in paragraph writing on live topics, such as are found in newspapers. The idea of this is to give pupils readiness, enable them to tell in a short time what they know. Each term two formal essays are written which are corrected by the teacher, handed back, and rewritten as many times as may be necessary to make them creditable productions. In the tenth, eleventh and twelfth grades the study of formal rhetoric is largely discontinued and we teach from literature. We use such works as Sir Roger de Coverley, Irving's Sketch Book, Macaulay's Lays of Ancient Rome and, later in the course, Shakespeare. These works are studied somewhat in detail; the beautiful passages are pointed out, and attention called to what is most excellent. The study of grammar and rhetoric is taken in connection with this. The writing of the short compositions is continued, the topics being taken from the work which the pupils are studying.

To summarize: In answer to the first question I would say, as many compositions should be written as can be without overburdening the teacher or scholars. It is impossible to state how many. That must be determined by circumstances. In answer to the second question, I have suggested that the teacher should correct comparatively few essays, that much of it should be done by the pupils themselves in class. In answer to the third question, I would say that in the ninth grade the subjects should be taken so far as possible from live topics—descriptions, narratives. In the tenth, eleventh and twelfth grades, from literature. In answer to the fourth question. I am in favor of using a drill-book whereby errors are brought conspicuously before the pupils.

PROF. HINSDALE:—Do you put a composition book into the hands of the pupils?

PRIN. WRIGHT:—We use Miss Keeler's book, each pupil being provided with a copy. Of course this book would be useless without a good teacher back of it.

PROF. DEMMON:—Do you think Miss Keeler's book as good a source of errors as the essays of the pupils?

PRIN. WRIGHT:—I think the two may be combined.

PROF. HINSDALE:—Is not Miss Keeler's book a book for the teacher, not for the pupil?

PRIN. WRIGHT:—I do not think so. We use it with very good results. Of course, as I said before, it needs a good teacher back of it. When pupils come into the High School they have had no practice in composition work. This book contains outlines. I think the first thing taken up is description—possibly the description of a bird is the topic. The subject is outlined, and pertinent questions asked developing the subject.

PROF. HINSDALE:—Ought not the teacher to furnish that?

PRIN. WRIGHT:—It is simply a matter of time. It is easier

for the teacher to have the principles, figures of speech, etc., written out, than to take the time to do this in class.

PRIN. GODDARD:—Is it not also true that there is much the pupils would never acquire unless it were written down and pondered over?

PRIN. WRIGHT:—I do not think pupils ever learn a rule so well as when it is studied out of a text-book and thought over before coming to class.

MR. E. L. MILLER, OF THE ENGLEWOOD (CHICAGO) H. S.:

The idea which has been put forward that there should be no special teacher of English but that the work of correcting compositions should be divided among all the teachers in a school is very surprising to me. The ability to correct compositions in any true sense of the word is an art in itself. To insist that our teachers of physics, for example, shall correct compositions means either that the work shall be poorly done or that we must employ men in our laboratories who are able to edit newspapers and write poems. To obtain such men for such positions is manifestly impossible. I believe most emphatically that every teacher in every branch should feel it a part of his duty to constitute himself the sworn foe of bad English; but I feel profoundly discouraged when I hear a member of the English conference advocating the degredation of the subject by leaving teaching of it in the hands of men who are not English specialists. The work of correcting has been stigmatized as a grind. It is a grind, as any work is a grind—to those who do not know how to do it, and to whom it should never be entrusted. To those who understand it, to those who are capable of performing it as it should be performed, it can never be anything but an unalloyed pleasure.

Not many years ago it was a practice well-nigh universal among teachers, I believe, to require their pupils to write about subjects selected apparently without reference to the interest or capacity of the children, or, indeed to any other principle discoverable in the physical or metaphysical universe. Most of us can remember youthful effusions on such inspiring topics as 'A Trip to the Moon,' 'The Charms of Solitude,' 'The Adventures of a Dime,' 'Culture and Life,' and 'The Evils of Celibacy.' Most of us can recall, too, with what bitter dislike the work of composition was commonly regarded by students in those evil days.

That this dislike was due, in some measure, at least, to the bungling and unscientific method of assigning work which I have described, and not to any inherently repellent quality in the subject itself, is an almost self-evident proposition. Man is naturally a writing animal. The cacoethes scribendi is practically universal. Most of us come into the world with the seeds of the divine desire in our blood. Nothing but an abominably bad system of instruction could destroy those seeds.

These considerations, as a matter of fact, finally led thoughtful teachers to work a reform. Subjects puerile in themselves and therefore useless for purposes of education, and subjects beyond the capacity of those who were expected to write about them came to be equally eschewed. The fact that in order to write well one must first have something to say received due recognition. The result of this recognition was a practical revolution of composition work along two distinct lines. In some instances, material was drawn from the pupil's own observations of men and things; in others, it was obtained from books. Both reforms were productive of great and lasting good, but each has brought with it certain evils. These evils and some possible remedies for them it is my purpose to discuss.

In cases where pupils have drawn their subjects for compositions from what we may, for want of a better term, ca'l 'life,' it has proved to be the case generally, that, while they usually found some thing to say, they were apt to make little or no progress in the art of saying it effectively. There was a more serious fault still. The process did not—and all educational processes should do this—the process did not lead them outside of their own narrow round of commonplace ideals and aspirations. By describing a game of base-ball or a railroad accident a boy gained accuracy of observation and expression, but he did so at the expense usually of elegance of expression and at the expense always of elegance of thought. Instead of idealizing, refining and clarifying his conceptions, the process had a tendency to make them vulgar, commonplace and confused.

The practice of drawing subjects from literature—especially the practice of writing book-reviews—has resulted in evils equally serious and more generally apparent. It is usually fatal to originality of thought and language. What is worse, it tempts the pupil to cheat. In many cases it fails to accomplish the purpose which constitutes its one claim to respectful consideration. It does not, in other words, even cause the pupil to read the book he is supposed to be reviewing. Instead of reading Shakspere's plays he reads Lamb's Tales from Shakspere. Instead of condensing Lamb's Tales from Shakspere he copies pages of them verbatim et literatim, though not usually punctuatim. Instead of forming a judgment of his own about the play he copies a few paragraphs from Dowden or Hudson or Mrs. Jameson. When he does make an effort to do honest work, unless he is exceptionally gifted, his writing is usually satisfactory in one of two ways. If he has tried to think for himself, his criticisms are painfully inadequate in both thought and expression. If he has taken his ideas from books and tried to put them into his own words, he has merely turned good English into English, which, if not bad, is pretty sure to be inferior. Both results, I need scarcely add, are comparatively fruitless and unsatisfactory.

Now, what is to be done to correct these pernicious tendencies? In what way can we help our pupils to stand upon a basis that is genuine, original, and firm; and which, at the same time, will keep before them a high ideal of both thought and expression?

In order to write well a man must be equipped with two implements. He must have something to say, and he must know how to say it. We must take both of these needs into consideration.

Latin teachers have a useful habit of basing work in composition upon the text of some author whose writing has been read and discussed. In this way propriety of diction is secured and a high ideal of style cultivated. The same principle, modified in detail of course so as to suit changed conditions, may be applied to work in English composition. If it be applied faithfully, energetically and with intelligence it will, I feel sure, go very far toward putting our work in composition upon a firm and salutary basis.

I do not wish or intend to put myself forward as the inventor of this method. It is not new. It is not untried. It is not visionary. It has been practiced, consciously or unconsciously, from the beginning of recorded time, by almost every poet and historian, by almost every philosopher and dramatist, who has attained to fame. While other methods have been producing the absurd and puerile effusions over which school-girls shed bitter tears and upon which school ma'ams bestow grim and ironical smiles, this method has been producing literature—if not of the first rank—at least of splendid and enduring vitality. Every bright boy who writes successfully for the college papers practices it. No poem wins a prize in the college annual unless inspired by its warm and invigorating influence. It is the universal recourse of youthful genius. Without its aid not three men in the last three thousand years have succeeded in forming a respectable literary style. Vergil took Homer for a model, Dante took Vergil, Milton took both and much more besides. Shakspere learned from Marlowe; Goethe, Schiller and Lessing went to school to Shakspere. Dryden formed his style on Juvenal's, Pope formed his on Dryden's. Dr. Johnson tried to imitate Addison. Burke's obligations to Cicero and Macaulay's to Burke are notorious. Tennyson imitated everybody. Austin Dobson draws from Praed. Praed drew from Moore, Moore from Prior, Prior from Herrick, Herrick from Horace, and Horace from Sappho and Alcaeus. If all these men, not to multiply examples *ad nauseam*, found this method useful, we surely cannot afford to despise it or overlook it. If it be true that "by their results ye shall know them," it may be pointedly asked what other method of teaching composition has such an array of results to which it can direct our gaze.

To reduce to practice this broad and far-reaching principle is an undertaking which will require much time, much experience, and much ingenuity. Its application to the needs of the class room, if

worked out at all, will have to be worked out by many teachers, through a long period of time. I wish, above all things else, to avoid the sin of dogmatism in what I am to say about that application. If I offer suggestions as to the manner in which the principle can be made a part of actual instruction, I offer them in all humbleness and merely as suggestions. If the form of what I say is dogmatic, the spirit in which it is uttered is not.

The work in English composition, then, should always go hand in hand with the reading of some masterpiece of literary style.

Of course there are many English classics the style and spirit of which it would be folly to ask a high school class to imitate. It would be a waste of time to set ordinary boys and girls to work upon effusions in the style of Spenser, or Milton or Shakspere. The proper grade of inspiration for this work will be found rather in such writers as Macaulay, Chaucer and Pope.

The method of procedure would be as follows: First, one of Macaulay's Essays, we will say the Review of Mr. Robert Montgomery's Poems, will be read by the class. Particular attention will be paid throughout the reading to the purity, the clearness and the vigor of the English, to the exquisite skill with which transition from sentence to sentence and from paragraph to paragraph is managed, to the masterly alternation of long and short groups of words, to the rhetorical value of figures of speech, and above all to the manly directness of the style. As soon as the reading of the review is finished, the class is to be required to write a similar review of the latest and worst book of 'poems' that ingenuity can unearth and money can buy. The results, I feel positive, will be highly gratifying.

It may be objected to this method that the embryo critic will contract many of the vices of Macaulay's style as well as some of its virtues. This I am quite ready to admit; but I feel very strongly that it is better to have even a faulty style than no style at all; that it is better to be wrong with Macaulay than right with the reporter of the morning paper. However, the danger from this direction can be much exaggerated. Of course any pupil by imitating one writer to the exclusion of all others, could contract a very objectionable style in a very short time. But my plan contemplates no such adherence to one man's manner. It aims to give instruction in many styles, and all of these will be colored and welded together into a new and original composite by the particular bias of each student.

Perhaps some of you will understand that I am in favor of an imitation that shall be servile and grovelling, an imitation which shall aim to reproduce the letter but not the spirit. I am anxious to guard against any such interpretation of my words. I wish the pupil to catch the spirit of an author's style rather than his accidental mannerisms.

The range of subjects which may be treated in the manner I have endeavored to describe is as wide as the universe. I shall suggest only a few. Macaulay's Review of Mitford's History of Greece may be made the basis of a similar review of any other history; his Conversation between Cowley and Milton touching the Great Civil War will furnish hints for a conversation between Jefferson Davis and Abraham Lincoln, or between Grover Cleveland and William McKinley. Upon his critique of Dante may be based a critique of the Sixth Book of the Aeneid; upon his paper on Dryden a paper on Pope; upon his article on the Civil Disabilities of the Jews an essay on the Civil Disabilities of Women; upon his biography of Frederick a biography of Napoleon or Alexander, and upon his letters and journals letters and journals descriptive of the pupil's own thoughts and acts. Boswell's biography of Johnson will show the learner how to report the substance of a conversation. Webster's Bunker Hill Monument oration will inspire an oration upon the Soldier's Monument in Detroit or the Statue of Lincoln in Chicago. Macaulay's report of the speech of Burke at the trial of Warren Hastings will show in what manner the debate between Webster and Hayne may be effectively described. The Laokoon will supply a fund of ideas that may be utilized in reviewing Mr. Howells' latest novel. Hawthorne's Twice-Told Tales will suggest similar transformations of other mythological stories. Irving's Legend of Sleepy Hollow will show how any local story may be worked up into a polished and glittering gem. John Burroughs' Roof Tree will render the task of criticising the architecture of the town in which the pupil lives easy and interesting; and his delectable treatise on the Woodchuck will enable a boy to write an appropriate essay on the House-Dog or the Squirrel.

Of course, as I have already intimated, the efficiency of this method, as of all others will depend to an enormous extent upon the ability of the teacher. In the hands of an instructor not thoroughly imbued with the spirit and art of the writer to be used as a model it would assuredly fail to produce respectable results just as any other system would under similar circumstances. In able and enthusiastic hands, however, I feel justified in proclaiming its immense superiority over every other method. It makes the pupil compose with his eye on the object. It teaches the secrets of artistic writing. It refines instead of degrading his ideas. It shows him how to think. It removes the temptation, nay, the possibility of his being dishonest. It causes him to read critically, to observe accurately, and to describe with precision. It makes him intolerant of slipshod work of any kind. It causes him to take an interest in the higher possibilities of the language. Best of all, it teaches him not only how to write well, but also how to read well; it improves his powers of expression and at the same time shows him a thousand subtle charms and artistic allurements, the existence of which he

never dreamed of before, and the full effect of which mere reading, however careful, can never teach.

SECOND SESSION—LATIN SYMPOSIUM.

At the meeting of Saturday morning, Professor F. W. Kelsey read a paper on "The Teaching of Latin in the High School." This paper, necessarily somewhat reduced in length, will appear in the June number of "The Educational Review." Some extracts from those portions of it not published elsewhere are given here, with as full a summary of the rest as the limitations of space will allow.

Our secondary Latin teaching is in a state of unrest. The evidence of this is to be found in frequent discussions of methods of instruction, but more particularly in the readiness with which high school teachers adopt innovations and carry them to an extreme, devoting themselves to what are termed 'fads.' Some teachers make a 'fad' of reading at sight.

"Another fashion, which sometimes degenerates into a pernicious hobby, is that of Latin talking. The best Latin teachers have always trained the eye, the hand, and the tongue at the same time in reading, writing and oral exercises; our best collection of colloquial phrases is still the *Colloquia* of Erasmus. But those who lay great stress on ability to talk Latin forget that it is possible for a man to know enough of a modern language, as German or Italian, to get about easily in the country of which it is the vernacular, and yet be unable to interpret a single page of the literature intelligently or accurately. There is no practical advantage to be gained now from the talking of Latin. I recall what Professor Mayor, of Cambridge, one of the most erudiate classical men in England, said on this point. I asked him, as we were standing in his library, whether he talked Latin; he said, "No," and justified his position by the consideration that it is not worth the while. In past centuries, when men had little else to study and Latin was still the language of the learned, it was not only desirable, it was necessary, to have the spoken idiom at command. To-day, the time given to the study of Latin has been so reduced that it should be devoted only to the most essential things. To the extent that colloquial exercises can be made to contribute to thorough scholarship in the subject, they are valuable; and they are an efficient means of lending life to a recitation. Beyond this point, they are apt to be a waste of time, except for the most advanced students who are already specialists in the classics."

Others still put undue emphasis upon the niceties of the Roman pronunciation of Latin—a subject full of pit-falls; and now with a large number of teachers the so-called "Inductive Method" is the

fashion of the hour. The only safeguard against being carried away to an extreme by the contagious enthusiasm of the man of one idea lies in the power of independent judgment, based on sound knowledge.

Several considerations were presented, showing that the reason for the widespread feeling of insecurity lies not in the alleged progressiveness of American Latin teachers so much as in lack of scholarly preparation for their work, and failure to improve themselves while teaching; and that the time has gone by when a student who has had only the Latin work required ordinarily in college courses for the degree of A. B., can be considered prepared to teach high school or preparatory Latin.

"Some light upon the range of work suitable for those who wish to teach Latin may be gained from a consideration of the qualifications exacted of Latin teachers in Germany, particularly in view of the tendency, which is making some headway among us, to introduce the teaching of Latin into the seventh and eighth grades." Taking the gymnasium system of Prussia, for example, we find that the requirements of candidates for teachers' positions are as follows:

All candidates for positions as teachers in the gymnasium are required to pass a rigid examination before a special commission appointed by the government. They must, first of all, indicate sufficient acquaintance with philosophy, pedagogy, and the German language and literature to meet not only the general demands of a gymnasium position, but also the special demands of the departments in which they wish to teach. With reference to the qualifications to teach particular branches, the nine years of the gymnasium course are reckoned in three divisions: three lower classes, *Sexta*, *Quinta*, *Quarta*; three middle classes, *Unter-tertia*, *Ober-tertia*, *Unter-secunda*; and three upper classes, *Ober-secunda*, *Unter-prima*, and *Ober-prima*. The departments of instruction are arranged in two groups:

i. *Philological and historical group:* German, Latin, Greek, French, English, History.

ii. *Mathematical and scientific group:* Mathematics, Physics, Chemistry and Mineralogy, Botany and Zoology. Geography is reckoned as an independent subject, which may be classed with either group according to circumstances.

The candidate must enroll himself in one of the two groups, and be prepared to teach four subjects, two selected as major subjects and two as minor. But the freedom of choice is restricted so far as this, that he who prepares to teach Latin in the upper classes must prepare himself to teach Greek in the lower and middle classes, and *vice versa;* while those who purpose to give instruction in French or English must be qualified to teach Latin at least in the lower classes; while teachers of history as a major subject must prepare to teach geography.

The requirements for those who wish to teach Latin and Greek are as follows:

1. For the lower classes.

Such a knowledge of Latin grammar as will assure good usage; an acquaintance, derived from reading, with the easier prose writers and poets; and the ability to understand and translate from them, as, for example, from Cæsar and Ovid, passages of moderate difficulty with grammatical and lexicographical exactness.

2. For the middle classes.

In addition to the sure knowledge of Latin and Greek grammar, there must be a grasp of the peculiarities of Latin style; also the ability to write both languages with grammatical correctness, the Latin particularly without grave offenses against style. In Latin, the candidate's reading must embrace at least Cæsar and Sallust, most of the speeches of Cicero, and some of his other works, considerable portions of Livy and Ovid, and of Vergil, at least the Aeneid; in Greek, Homer, Herodotus, Xenophon's Anabasis, and one other of his works; the speeches of Lysias, the minor political speeches of Demosthenes; his knowledge of all these, apart from passages of peculiar difficulty, must be sound and sure. In the history of the Roman and the Greek literatures, in metres, antiquities and mythology, candidates must be so well informed that they will be able to appreciate the need of more special knowledge as they come to the passages requiring it, and to avail themselves of the help of good sources of information.

Such are the qualifications exacted for the part of the gymnasium work in Latin and Greek, which corresponds roughly with the Latin courses in our high schools and academies. Those who desire to teach these subjects in the upper classes, the work of which in general corresponds with the work in classics required for a degree in American colleges, must meet further requirements thus:

"Extensive reading in the Roman and Greek classical writers, especially in the domain of gymnasium work; strictness of method in explanation, readiness in the use of the Latin language both orally and in writing; grammatical correctness in the writing of the Greek language. The knowledge of Latin and Greek grammar must be brought into scientific coherence. In the history of the literatures, metres, and antiquities the candidate must have laid a foundation of knowledge so secure that the methodical extension of this knowledge later is assured; special familiarity with the literary history and metres of the authors read in the gymnasium is required. In the domain of mythology and archæology, the candidate must be so well informed as to be able to make effective use of good sources of information when necessary, and to help the work of instruction by the proper use of illustrative material.

Furthermore, as an additional qualification for the teaching of the higher and middle classes in Latin or Greek, a knowledge of Roman history is required into the first century of the Empire, and of Greek history to the time of the Diadochi. As a qualification to teach Latin and Greek in the higher classes, an acquaintance with the Græco Roman philosophy adequate to serve in the interpretation of the classical writers is required.

In the latter part of the collection of enactments and bulletins* on which the preceding statements have been based, there are some remarks bearing upon the provisions and explaining their purpose. Among them is this regarding the qualifications for Latin and Greek work (p. 37):

"The central point of the requirements set for teachers of Latin and Greek in the middle and higher classes lies in a wide range of reading, strict method of interpretation, and the consequent mastery of the language in form and content. If complaint be sometimes made that pupils lack interest in the instruction, or that the results of instruction are inadequate, we cannot help wondering whether the teacher has made himself sufficiently at home in the language and literature which he professes to teach. It is for this reason—entirely apart from the requirements of work of research—on purely practical grounds, that so great emphasis has been laid upon extensive reading."

It would be as inexpedient as it is impracticable for us to import the gymnasium system as it stands, but I doubt whether there is any among our teachers that have tried to teach Latin conscientiously, who will say that the Prussian requirements for the different grades of Latin teaching are too high. Turning now to our own conditions, we find that the requirements in Latin for teaching in the middle and lower classes of the gymnasium cover in general the ground of our Latin courses (at the University of Michigan, for example) leading up to and including the course for teachers, together with a year of graduate work. In other words, the student who has successfully completed the two years of work in Latin required for a degree, has elected four or five hours a week in the subject during the last two years of his undergraduate course, and then has taken a year of graduate work with Latin as one of his three lines of work, may be pronounced well equipped for a high school position."

The paper discussed at some length the relative advantages of a year of graduate study for the high school Latin teacher in an American as compared with a foreign university; and urged the organization of a Latin conference to stimulate independent work

*Die Prüfungen für das Lehramt an höheren und Mittelschulen, edited by Dr. H. Kratz. Leipzic

among high school teachers, as well as the founding of a Classical Quarterly devoted to their interests.

In the discussion following the paper, the following gentlemen took part: Prin. J. G. Pattengill, Prin. F. L. Bliss, Prin. E. C. Warriner, Mr. J. H. Harris, Supt. W. H. Honey, Mr. E. L. Miller, Supt. A. F. Nightingale, Prin. F. N. Sherman and Prof. B. L. D'Ooge.

PRINCIPAL J. G. PATTENGILL, OF THE ANN ARBOR HIGH SCHOOL: *

The chief good which must come to us from Prof. Kelsey's paper is the inspiration which it gives to the profession to live on a higher scholastic plane and to appreciate more clearly the superiority of knowledge over method. The American secondary schools are now attracting such attention as they have never received before. Too great a share of this attention is at present directed to matters of mechanical detail. All this pottering and tinkering with courses and methods will accomplish but little permanent good, unless the standard of the profession is raised. I use the word 'profession' somewhat proleptically, for teaching in the secondary schools has hardly yet acquired in this country the rank of a profession, and not until it does shall we get the best work in this department of education. But I am optimistic enough to believe that the time is coming when the career of a teacher in the secondary schools will be regarded as an honorable one, and worthy of any man's ambition.

Among the objections to the profession of secondary teaching, is its burdensomeness. Some of this is unavoidable, and should be looked upon as one of those unpleasant features from which no profession is entirely free. But some of the burdens are needless and ought to be removed at once. Among these may be mentioned the heathenish custom (undoubtedly a device of the great adversary of human souls), of requiring teachers to prepare a lot of senseless statistics which are of no earthly use to either man or beast. It is little better than highway robbery to take from the teacher for no good purpose, time which could be used to some profit for himself and his pupils.

A more serious objection to our profession on the part of a man of scholarly tastes and instincts is the lack of a scholastic atmosphere. It may be said that a real scholar ought to find in his own library sufficient stimulus, and should not be dependent upon his surroundings. This sounds well. However, we all know that comparatively few of us are built on that plan, and that we need the contact and sympathy of those engaged in similar pursuits. This natural want can, for most teachers, only be met by the formation of such a club or conference as Prof. Kelsey has suggested. This will not entirely take the place of daily contact with scholars, but

* Prof. Pattengill's paper appeared in the Michigan School Moderator for May 3.

will be a very great help and inspiration, for into it shall in nowise enter anything that defileth by wearisome talk about methods or that discovereth pedagogical mare's nests. But the benefits of such an organization have been set forth so clearly by Prof. Kelsey, that nothing further need be said on that subject; the main thing is to get started at once. It seems to me desirable that the conference should be classical—including in its scope, Greek, as well as Latin. The two subjects could be considered together at one meeting or separately at alternate meetings. But this is a matter of detail that can easily be arranged.

There are, undoubtedly, teachers present who are conscious that they fall far below the high standard which Prof. Kelsey has set for our profession. I know of, at least, one such, and as Mark Twain says, 'that's me.' To some of these Prof. Kelsey's paper may bring a sense of discouragement. Now I do not feel that his words should discourage us in the least, if we have the right spirit, and have not wholly lost the 'divine hunger for books.' They should rather be a stimulus—a call to 'lay aside the sins which so easily beset us,' and to devote ourselves with energy and perseverance to the task of self-improvement. Suggestions have already been made as to the best means of increasing our attainments. It may, however, not be out of place to call attention to some ways by which the amount of time at the teacher's disposal may be increased, since all are not so situated as to be able to devote their whole time, even for six months, to the study of Latin or Greek, or to foreign travel. It is obvious that everything which tends to the misuse or wasting of time must be avoided. Among the chief time-wasters I will mention the following:

1. The daily paper. I mean the abuse—not the use of the daily. For it goes without saying that the teacher should be well informed on current events. To attain this end it is not necessary to wade through a large daily newspaper every day, studying carefully all the details of the various criminal trials reported. A few minutes at resting time given to running over the headings and selecting such paragraphs as are worth an intelligent person's reading, are sufficient. I know of one gentleman, who, during the past winter, saved enough time from that usually given to the daily paper to enable him to read Stanley's lectures on the 'Eastern Church,' two volumes of Gibbon and one volume of Reuss's 'History of the New Testament,' and that too, without any loss of knowledge of important current events. Were it necessary, I could give other examples from personal observation, but enough has been said, I think, to establish my point.

2. The magazines. What has been said of the daily newspaper is equally true of the magazines. There is really very little in them that the scholar can afford the time to read.

3. Other current literature. This subject admits of substantially the same treatment as the two previous one. The rule not to read a book less than five years old is a good one, though all such hard and fast rules are difficult of application. At any rate it is manifestly unwise for those who can read works that have endured more than twenty centuries, to spend much of their limited spare time in reading those which will be forgotten in as many months. Frederick Harrison's essay on the "Choice of Books" will be found a very valuable tonic. A careful reading of this should enable one to confess total ignorance of the latest literary fad without a twinge of shame.

4. Outside matters. The teacher ought of course to do his duty as a citizen and member of society. But often absurd and needless demands are made upon him which he ought to have nerve enough to reject. In some places the superintendency of the Sunday School is considered one of the regular perquisites of the principal of the High School. To this is often added the chairmanship of numerous committees and the director-generalship of the local literary society or reading circle. Now teachers often have an object lesson on this point right in their own class rooms; for when a pupil tries to excuse poor work on the ground of social or religious duties, the excuse is not apt to be very graciously received. If this is bad in the pupil, it is worse in the teacher. Besides, is it not questionable morality to devote to church or society, time stolen indirectly at least from the pupil?

It is not necessary to dwell any longer upon the various time-wasting influences. If the disposition to save time is present, the means can generally be found.

In using our spare time, it seems to me that the best results will be obtained rather from extensive reading than from philological study. The cultivation of the taste and the broadening and enlivening of the intellectual powers are the generally conceded effects of reading. These are of immediate and constant value in the class room, while philological learning should be but sparingly used. There is a constant temptation to the skilled philologist to use more of his learning than is of any value to the pupil, and sometimes even to make an idle display for the sake of inspiring awe in the minds of the young innocents before him—to "play to the grand stand," as it were. I do not wish to be understood as putting a low estimate upon philological study, but only as expressing my ideas on its relative value for teachers in secondary schools.

Prin. F. L. Bliss, of the Detroit High School:

I suspect that I have a great deal of company and sympathy in the feeling Professor Kelsey's paper has produced. I fear that if it

had the same effect upon others that it has had upon me, there would be a great dearth in the supply of teachers next year; they would all come back to the University for a year or two of special preparation for work they now feel unprepared to do. I think every teacher, not only of Latin but of every other subject, should thank Professor Kelsey for the high standard he has set before us.

At the same time, while the pendulum has perhaps swung far in one direction, and method exalted to the exclusion of scholarship, there is a possibility of letting the pendulum swing a little too far the other way and exalting scholarship at the expense of method. There is no doubt that the word *method* has become odious, and has come to mean a substitute for scholarship, a mysterious something by which results can be obtained without the aid of scholarship; but we must not let the revulsion of feeling thus caused lead us to underestimate the value of a good method.

The proper method of presentation of any subject to a class is simply a conscious system on the part of the teacher presenting that subject. This definition of method would seem to carry with it the conclusion that we need not only much scholarship but also much method. Unquestionably, in my mind, the secret of one great difficulty in the teaching of Latin has been a lack of scholarship and a lack of a conscious system in presenting the topic.

In teaching beginning Latin classes, we have attempted to do too much and too little. We have tried to do what we ought not to do, and left undone what we ought to do. The result is confusion, and practically much of the first year's work has to be done over again in the second, the third, and even the fourth year.

Something has been said of the undue exaltation of the text-book. The text-book is important in that it saves time. We all know that one of the fads of the day,—indeed, it is not new, I remember it ever since I began teaching,—is the idea that the child must be continually entertained, that each step in his education must be so easy that he advances by unconscious means until he has attained something like scholarship. Very few really believe that scholarship is ever attained in that way. No one will ever become a scholar in any line of study until he learns to work by himself. The text-book should be so written as to be his guide in this independent work, and it is especially important during the first two years. The question of time is important. Many things that teachers must consume hours of class time in explaining might better be carefully explained in the elementary text-book. And the student is gaining much more of a scholarly habit by mastering this explanation by his own effort than by merely drinking in the explanation of his teacher. While the teacher's province must ever be to guide and suggest, a very important part of his class work should be to see that his pupils are learning to work by themselves by means of the explana-

tions of a well written text-book. I feel perfectly sure that the elementary text-books err on the side of too many things introduced and not enough of elucidation of those introduced, rather than in the opposite direction. Teachers often fail to anticipate the difficulties that confront the beginner, and perhaps current text-books fail even more in this direction. The good book and the good teacher will anticipate the common errors and misconceptions of beginners, and by proper guidance enable them to avoid them. Everything lies in a proper presentation of a subject at the beginning.

A common mistake, it seems to me, is in keeping the grammar out of the hands of the pupils for the first year or the first and second years. I am inclined to think the first lesson in Latin should be on the use of the grammar as a book of reference. The student should be taught that the grammar is a guide, and should learn by its aid to work independently. Without a systematic and orderly arrangement of the facts studied one's knowledge can be of little avail. This orderly habit can best be obtained from a systematic study of the grammar. Here again in avoiding the extreme of memorizing a grammar with little reference to practice, we have gone to the other extreme of neglecting the formal study of grammar. Confusion is apt to follow. As the so-called inductive method is very apt to lead to this confusion, its dangers in the hands of all but the ablest teachers can hardly be exaggerated.

Several years ago I was given charge of a class in Cæsar that was in a way a perfect marvel in what may be called Latinistic gymnastics. They could give the declensions 'backward and forward and skipping around' faster than you could follow them; but when they came to translate, I noticed a peculiar thing: whenever they came to the present subjunctive they would translate it by 'can' or 'may,' and the imperfect subjunctive by 'might,' 'could,' or 'would,' no matter what the dependent construction might be. After two years there were pupils who would still translate a clause of purpose by 'might,' 'could,' or 'would,' as the case might be. The teacher of these students during their first year had had little more than a high school training, and not much of that, I fancy. They had done remarkable work in one direction, but had no idea of the aim of their work in Latin, or of the essential characteristics of the language. It was simply a matter of philological pyrotechnics on certain show days. And they did make a marvelous showing, but they knew practically nothing of the language. With a high grade of scholarship in the teacher, and a conscious system in the presentation of the subject, all this wicked waste of time would have been avoided.

A special difficulty confronting most of us, which in a measure Mr. Pattengill has met, is that of saving time on the part of the teacher, for advanced work. It is especially hard for teachers in

smaller schools, where they have a variety of subjects to teach, to find time for advanced study. I remember at one time having seven classes and seven different subject, one of them being beginning Latin. When I intimated to the Superintendent that I could do better work with fewer subjects, he informed me that he thought that I had what he was pleased to call a 'snap.' I realized that I was not doing good work in any one line. This lack of time, after the teacher has entered upon his duties as teacher, forms one of the strongest arguments in favor of the high standard that Professor Kelsey has set before us, and I think we all should use every effort within our power to establish this high standard, that those at least who shall hereafter come into our ranks may have the broad foundation which he has suggested.

PRIN. E. C. WARRINER, OF THE BATTLE CREEK HIGH SCHOOL:

I do not believe the conscientious high school teacher can find a great deal of time for advanced study and do the work he ought to do in his classes. His pupils own his time and he cannot and he ought not to put much time on outside work. The bulk of the teacher's advanced work after he leaves college must be taken during vacation, and to this end I am glad the University is providing summer courses. Although in Latin some advanced work is offered, I think other courses would be appreciated by those teachers in the state who could spend their vacation here; perhaps other courses would be offered if a demand were made for them.

I think that in general the School Boards are criticized too severely. If teachers show enthusiastic interest in their work, their requests for additional material in the way of maps, charts, etc., will be granted. However, there are various other ways in which money might be raised for purchasing this illustrative material. The proceeds from the Junior Exhibition might be used for this purpose, and other entertainments might be given.

In regard to the marking of the vowels in the text-book, if the vowels are marked in the first year text-books, I think it is sufficient. If thorough work is done during that year the accents will have become fixed in the student's mind. and after that the marked vowels are a hinderance rather than an aid.

Now a word with regard to the Latin Conference. I think that the conference for this state should be held in Ann Arbor, because the greatest good would result from the meeting of the professors of the University with those engaged in classical work in secondary schools of the state. The meetings should be held once a year; one meeting of the Schoolmasters' Club might be devoted to the Conference, the other to the general work of the Club.

MR. J. H. HARRIS, OF THE ORCHARD LAKE MILITARY ACADEMY:

I have some hesitancy in taking part in this discussion as I feel the time should be occupied by older teachers than myself,—those who have had more experience. One point with reference to terminology I should like to touch upon. I am not certain that I understand the force of the word 'unseen' in 'unseen translation.' I think I understand what Professor Kelsey desired to bring out—that sight reading, sight translation is to be practiced for the purpose of getting at the sense of things—but I would like to ask Prof. Kelsey to explain a little more fully the meaning of the word 'unseen.'

PROF. KELSEY: Mr. Harris is right in his interpretation of the word 'unseen.' The choice of that word was perhaps not a happy one. It is a word very commonly used in English schools for 'sight reading.'

MR. HARRIS: In regard to the matter of pronunciation, I have secretly felt that we needed to have quantities marked, at least in the first books. I do not think we need necessarily use marked quantities as a crutch, but rather as an example, as a model. I do believe every long quantity should be marked during the first year.

SUPT. W. H. HONEY, OF FLINT, MICH.:

If asked what are the three essentials of a good Latin teacher, I think we might apply the saying of Demosthenes,—first, knowledge of Latin; second, knowledge of Latin; third, knowledge of Latin. To gain this knowledge one must become thoroughly conversant with Latin literature. Through the reading this involved, one would gain some knowledge of archaeology, and other subjects connected with Latin; his interest in the subject would be aroused, he would feel increased power, and that power would spur him on to do better work.

What would be the best way to produce the ideal teacher of Latin? I think those who show special ability for such work should be selected early in their school life. They should be led to think of this as their life work and all training should be to this end. Enough work in other branches should of course be given them so as not to make them narrow. In this way we would in time have much better prepared Latin teachers than at present.

The knowledge which such teachers should have includes three things: First, the power to read Latin as rapidly and as well as English. This would involve the reading of an enormous amount of Latin literature. They should read nearly all Latin literature. (I say *nearly* all, I think they should read all). Second, the power to think in Latin. To this end I think there should be classes at the University where Latin is spoken. Third, knowledge of the Latin vocabulary. Preparatory schools seem to be weak in this

respect. Pupils often get false ideas of the meanings of words. Teachers might do more work in explaining primitive meanings of words, the pupils themselves deriving meanings and thus working along the line of independence.

I think text-books should be used for the lower grades, especially the seventh and eighth grades. I do not believe in so much work being done in grammar, except for those who wish to make a special study of it. Let what is done be done more thoroughly and let more reading be done.

I speak with some hesitancy on the subject of marking vowels. I see no reason why vowels should not be marked for some considerable time in the first part of the course. It would certainly save time in the fourth year's work, especially, and in the reading of poetry. Why should not long vowels be marked in Latin, when in Sanskrit, a language which is regarded as quite perfect in its representation of sounds, long vowels are denominated by certain distinct additions to the characters used for short vowels?

MR. E. L. MILLER, OF THE ENGLEWOOD HIGH SCHOOL, CHICAGO:

It seems to have been decreed by the fates that the study of Latin should always be hampered by some ridiculous fad. Why this should be so is a question which has puzzled me ever since the day I took my first lesson in a Latin classic At last it has been answered to my satisfaction by Prof. Kelsey, who has so ably shown us how and why the lack of real scholarship compels many of our teachers to resort to showy and vicious expedients for the purpose of dazzling the eyes of their pupils and deceiving the public. Every four or five years the fad changes; but the teachers do not change; and it will be found, upon investigation, that those who were most illogical and enthusiastic in championing the old absurdity are loudest in expressing their approval of the new.

Ten years ago the favorite Latin fad was syntax. Etymology, philosophy, human interest and literature had all been forced into the background by it. In many of our schools the noblest writings of antiquity were placed five times a week upon the philological dissecting table and irreverently butchered by the pedant and the grammarian. Thanks to the misplaced enthusiasm of the devotees of syntax, the study of Latin had become a by-word for all that is impractical, repulsive and dry. Owing to the hostility thus excited the magazines were filled with articles in which Latin teachers and Latin methods were held up to ridicule; and the position of what is probably the most useful study in the school curriculum was for a time seriously threatened. Opportune reforms averted this calamity, but not before irreparable harm had been wrought in the intellectual equipment of countless boys and girls, who had been pre-

vented from undertaking the study of Latin because of the absurdities that had crept into the teaching of the subject.

To-day, owing to a fresh fad which has insinuated itself into the good graces of many teachers throughout the country, we are threatened with a repetition of this disaster. I refer in general to the great and disproportionate attention which has of late been bestowed upon the matter of quantitative pronunciation, and in particular to what is said on this subject in the report of the Committee of Ten.

Among other things we are told by those high in authority that the importance of a correct pronunciation of Latin must be emphasized from the very beginning of the study; that if this be done much time will be saved when the pupil comes to read poetry; that in order to do this all long vowels must receive full length in all syllables;* that obstructed consonants must be pronounced with the utmost care so as to produce the proper quantitative effect; that unless the proper quantitative effect be produced the literature of the language cannot be appreciated; that a final vowel must in either verse or prose be run as a glide into the next word, provided that word begins with a vowel or with h; that correct pronunciation is impossible unless the quantity of every syllable be known; that long and short vowels differ not only in quantity but in quality; that final m preceding an initial vowel or a vowel with h should be pronounces as a faint nasal sound, the lips approaching the ordinary m position but not touching; that, as these facts are true, they ought to be taught as a matter of scientific accuracy whether there is any other reason for doing so or not.

Apropos of these contentions, I have seven points to make. First, the importance of a correct pronunciation of Latin or any other language is infinitesimal as compared with the importance of its etymology, its syntax, or the appreciation of its literature. Second, we cannot emphasize the importance of a 'correct' Latin pronunciation because we do not and cannot know what the 'correct' pronunciation was. Third, if we did know what it was, it would be a waste of time to go into all its details. Fourth, quantitative reading is not needed to bring out the beauty and power of Latin prose and verse. Fifth, time is not saved by teaching quantity in the first year. Sixth, there are considerations in teaching which vastly outweigh considerations of scientific accuracy. Last and most important, the best interests of Latin study demand that the teaching of the subject be kept free from fine-spun and useless theories.

I. Let us examine each of these propositions somewhat in detail. The importance of a correct pronunciation of Latin or any

* For example the teacher who says *amo, amare amavi, amatum*, in the manner of his forefathers instead of *amo-o, ama-are, ama-avi-i, ama-atum*, is to be regarded as slipshod and unscholarly.

other language is infinitesimal as compared with the importance of its etymology, its syntax or the appreciation of its literature. The study of Latin etymology deepens and enriches the pupil's knowledge of his own tongue, teaches him something of the principles of comparative philology, and shows him the truth of many valuable historical facts. The study of Latin syntax teaches him how to think and reason for himself and makes clear to him the whole science of grammar. The study of Latin literature speaks for itself. No such arguments can be brought forward in favor of the study of the Roman pronunciation, and the study of Latin quantity which the study of the Roman pronunciation implies. The mastery of it involves no mental process save the mechanical exercise of the memory. A parrot or a crow can be taught to say *peto-o* with as much unction as a college sophomore. The mastery of the arbitrary facts of quantity confers upon a person just the sort of intellectual training that would be obtained by him if he were to learn a list of all the post-offices in the United States. If we insist on teaching those facts in the interests of scientific accuracy, the teachers of geography may with equal reason insist on teaching their pupils the location of every farm house and telegraph pole in existence. The fact that a man knows that the *e* in *peto* is short will not render him more acute, will not make him wiser or better, will not add one jot or tittle to his refinement or his culture.

II. My second point, that we ought not unduly to emphasize the importance of a 'correct' Latin pronunciation, because we do not and cannot know in all details what the 'correct' pronunciation was, has been sufficiently discussed by Prof. Kelsey. There is nothing to add to his admirable remarks on the subject.

III. My third point, that if we did know what it was, it would be a waste of time to go into all its details, has been already touched upon. For us, teaching as we do a language that is never spoken, a language the correct pronunciation of which is a matter of doubt, the simplest system of pronunciation is the best. Each letter should be given one sound and only one. Previous to the beginning of the work in poetry enough quantity should be taught to enable the pupil to accent the words correctly, and no more. There are so many really important things which must not be neglected that we cannot afford time for more than this.

We are told that if a thing is worth doing at all, it is worth doing well; and that it is wrong on ethical grounds not to go into this matter to the fullest extent. To this I reply that the quantitative system of Latin pronunciation, owing to the enormous difficulties of its mastery and the meagre results of its attainment, is not worth 'doing' at all. Moreover, unless we pretend to teach a thing which we in reality are not teaching, no ethical principle is endangered. If we frankly admit that we are teaching a system of pro-

nunciation designed only for the practical business of the class room, being careful not to carry the idea that we are teaching the 'Roman' method, I cannot see that we are violating any moral law. I do feel very keenly, however, that when we force some poor boy, who is struggling hard to snatch another year or two of schooling from the grim demands of poverty, to waste his time feeding upon such wretched intellectual straw as Latin quantity, we are violating some very weighty moral laws.

IV. Quantitative reading is not needed to bring out the beauty or power of Latin prose or verse. If it were, we should be forced to conclude that all the men who, previous to the beginning of the movement toward its introduction, have expressed their admiration of Vergil's wonderful verse have been deceived into believing that it pleased them or have failed to tell the truth about the impression it produced upon them. Either charge, I fancy, would be moderately difficult to prove against Edmund Spenser, or Samuel Johnson, or Thomas Babington Macaulay. It is hard to believe that the man who wrote Paradise Lost had no appreciation of the power and beauty of the Aeneid; that Dryden was talking merely for effect when, referring to Vergil's verse, he exclaimed, "Good heavens! how the plain sense is raised by the beauty of the words"; that Scaliger was uttering *vox et praeterea nihil* when he spoke of the incomparable delicacy of the numbers and harmony of Vergil's versification; or that Tennyson, who wept over the tale of the fall of Troy, and loved to call its author 'dear old Vergil,' was merely shamming. If it be true that we cannot appreciate the majesty and power of Vergil's verse without the quantitative pronunciation, why did Coleridge, who held Vergil in contempt, speak of his numbers and his versification with respect? There is certainly no evidence to show that these men ever heard of the Committee of Ten or the quantitative pronunciation.

A considerable degree of appreciation has been bestowed on Shakspere during the present century; at least the present century has flattered itself that such is the case. Yet nobody now pronounces Shakspere's words as his contemporaries pronounced them. Can it be that we have utterly failed to appreciate Shakspere's genius because of our failure to retain the Elizabethan pronunciation? Is it possible that the subdued and elegant reading of Henry Irving and the heroic declamation of John McCullough and the lordly elocution of Edwin Booth have alike failed to interpret the great bard, because, instead of saying, as Burbage did,

"A baste, that wants discoorse of rayson,"

they have modernized it into

"A beast, that wants discourse of reason?"

It is certainly not judicious to insist upon the necessity of resurrecting a Latin pronunciation 2,000 years old, when we pay no

attention to an English pronunciation not one-tenth as ancient. As a matter of fact, effective reading does not depend on the physical sound of the letters, but on the feeling and intelligence put into their interpretation by the reader.

V. We come now to the proposition that if quantity be taught in the first instead of the fourth year much time will be saved. Leaving out of consideration the fact that the work of the first year which is already of necessity a hard grind will be rendered still more distasteful by the infliction of this work in quantity, we are confronted by the additional fact that of every ten pupils who take beginning Latin not more than three ever read a line of Latin poetry. Now, as the only reason for learning quantity is to enable the pupil to read verse, the time spent by seven of these pupils in learning quantity is utterly wasted. Even if such a consideration had no weight I am not all ready to admit that this plan would save time. In the first place it is worse than useless to teach a thing before it is needed. To teach quantity in 1894 that will not be needed until 1897 is much like buying eggs in January that will not be needed until December; one will be about as fresh and serviceable as the other when the time to use it comes. In the second place, to assert that a boy of 14 will learn anything more quickly than a boy of 18 is absurd. To do so is practically to assert that the four years in the High School not only do not sharpen a boy's wits but actually cause them to grow dull; which is quite preposterous, because it is impossible that most of the boys who come to us should grow any duller than they are when they enter the high school. If it be really true that quantity or anything else can be taught in less time to a freshman than to a senior we are all making some egregious blunders. Hereafter we must be careful to give our classes in Cicero shorter lessons than our classes in Cæsar and our classes in Vergil shorter lessons than our classes in Cicero. We must begin in September with very long lessons and gradually shorten them so as to keep pace with the constantly decreasing ability of our classes to learn. And, after the boys and girls have gone away to college we may expect to learn that they, like many of their predecessors, are passing their time in ease and sloth, not, like those predecessors, because they are simply and honestly lazy, but because they have been educated until they have lost all ability to perform intellectual labor.

As a matter of fact it is not at all difficult to teach a class that has never heard of quantity to scan Vergil in a very few lessons. No rote work in the memorizing of rules is necessary.

After the structure of the hexameter has been explained through the medium of some English verses like Coleridge's lines on the Homeric hexameter :

"Strongly it bears us along on its swelling and limitless billows,
Nothing before and nothing behind but the sky and ocean."

the first line of the Aeneid may be written on the board by the teacher. He will then proceed to explain how the quantity of each syllable in the line may be determined. As soon as the reason for the quantity of a syllable is developed, he will write underneath the line the working rule by means of which it is known. After a few lines have been treated in this way the board will look somewhat like this :

2 7 4 10 11
1 3 4 2 5 4 6 8 9 4
Arma vi | rumque ca | no, Tro | iae qui | primus ab | oris.*

1. The first syllable in a hexameter is always long.
2. When a vowel is followed by two or more consonants the syllable is long.
3. Final *a* is short, except in ablatives and imperatives.
4. One short syllable never stands alone.
5. Que is short. The "u" is a parasite of the "Q," and "ue" is not a diphthong.
6. Final *o* is long.
7. Three short syllables never stand together.
8. A vowell followed by the consonant *i* is long.
9. Diphthongs are long.
10. Two long syllables imply the presence of a third.
11. Feet 5 and 6 are always scanned — ⏑ ⏑ | — ⏓

11
1 4 12 7 4 6 13 11 2 4
Itali | am, fa | to profu | gus, La | vinaque | venit

12. A vowel followed by another vowel is short.
13. When, by assuming that certain syllables are long or short, you can make the line scan correctly, do so. In order to verify results in such cases it is well, of course, to consult the vocabulary or the dictionary.

7 10 15 11
1 4 2 2 14 2 14 2 2 2 2
Litora, | mult(um) il | l (e) et ter | ris iac | tatus et | alto

14. When a word ending in a vowel or a vowel followed by *m* precedes a word beginning with a vowel or with *h*, the vowel with *m* or the final vowel is dropped (elided).
15. Is in the dative and ablative plural is long.

11
1 13 13 2 9 9 13 13 2 4
Vi supe | rum sae | vae memo | rem, Ju | nonis ob | iram

* Exceptions are treated as they arise. It is best not to anticipate them.

5 11
2 3 4 14 2 2 6 2 2 2
Multa quo | qu(e) et bel | lo pas | sus, dum | conderet | urbem

1 11
2 2 2 5 4 2 4 12 6 13 13
Infer | retque de | os Lati | o, genus | unde La | tinum

17 11
1 4 16 5 4 7 2 14 2 9
Alba | nique pa | tres, at | qu(e) altae | moenia Romae.

16. Final *i* is long.

17. If a mute or liquid with l or r follows a vowel the quantity of the syllable in which the vowel stands is common. Thus if we say pat-res the first syllable is long; if we say pa-tres, it is short.

As each rule is developed, the learner will write it with its number in his note-book. After a few lines have been treated in this way by the teacher, the pupil may be set to work analyzing other lines for himself His work will be simplified if he will at this point review his conjugations and declensions, learning the quantities of the terminations. By the time the class has analyzed 150 lines they will have a thorough knowledge of the mechanical structure of the verse. After that the work in scansion should consist of reading, and the utmost effort should be made to get the pupil to read as if the verse meant something. In my opinion there are two great advantages in this method of teaching scansion. In the first place it saves time. In the second place it exercises the reasoning faculties, while the process ordinarily employed and the process suggested by the report of the Committee of Ten are both purely mechanical.

VI. There are considerations in teaching which vastly outweigh considerations of scientific accuracy. The fact that a thing is true is no conclusive proof that it should be taught. The capacity of the human mind is limited. The time at our disposal is terribly short. We cannot teach everything. It is our solemn duty to teach only those things which have a distinct educational value. If we confine ourselves to matters the teaching of which can be fully justified from every point of view, we cannot hope to give instruction in a hundredth part of the things that it would be well for our pupils to know. We must not look at these matters as Latin teachers or science teachers or English teachers, but as human beings. We must remember that it is not our business to make Latin teachers or scientific experts or poets and orators, but to train men and women. Let us be broad and liberal. I have been in a class of fifty college sophomores of whom a very large percentage would have regarded a misplaced iota subscript or a false quantity with horror; and yet not one of that class could tell how many lines there are in a sonnet. I have seen college seniors who could not write ten pages of fools-

cap without misspelling words and misplacing marks of punctuation. As long as such abominations as these exist, we had better not be too particular about making freshmen in the high school pronounce the final m preceding an initial vowel or a vowel with h as a faint nasal.

VII. The best interests of Latin study demand that the teaching of the subject be kept free from fine spun and useless theories. As a class, I believe we try to teach too many things. Our motto should be *Non multa, sed multum.* If we insist too much upon the minutiæ of the subject our students will lose sight of its vital principles. In their efforts to remember the quantity of the *e* in *peto* they will forget that a verb of saying is not followed by the subjunctive. If we would teach less we would teach more. It is easy to learn and remember a few rules. If those rules are repeated and driven home day by day and week by week they become at last an integral part of the very being of the learner. If, however, the teacher, instead of repeating the great cardinal principles of a subject until they have been mastered as I have described, compels his pupils every day to learn a mass of fresh detail—the result invariably is that the pupil learns nothing in such a way that he really knows it. At present too many of our graduates remind one of Macaulay's felicitous characterization of Lord Brougham—they half know everything from the cedar to the hyssop. A better ideal would be that they should know a few things perfectly, and know where to find information about the rest. Then we should not need to fear as we do now that some successful business man would aim at us an arrow tipped with a wing from our own plumage, by pointing derisively at the results we obtain, and quoting with only too much truth the one hexameter which still clings, as a lonely and mournful reminder of unprofitable hours and wasted opportunities, in a memory burdened with the quotations of March wheat and Standard Oil:—

Parturiunt montes, nascetur ridiculus mus.

MR. A. F. NIGHTINGALE, SUP'T. OF HIGH SCHOOLS, CHICAGO:

I am a little at variance with the position taken in regard to the marking of long vowels in Latin text-books. It is claimed that vowels should be marked during the first part of the work, and *if* the work is done properly, the pupil will find little difficulty thereafter. 'Aye, there's the rub.' This 'if' is the greatest obstacle that we meet with. I have been more discouraged in Chicago in my efforts to induce teachers to be watchful of quantity during the first year's work than I have been in any other phase of the subject. There is not so much difficulty with the vowels in the penult and antepenult as with other vowels. Often the teacher's knowledge is deficient; in fact, it is quite impossible to find college graduates who

are willing to focus their life work upon first year Latin. All good teachers of Latin are anxious to teach Cicero, or Ovid, or Virgil, and we are compelled to place young pupils at the most important period of their Latin study in the hands of those largely inexperienced and often incompetent. In my twenty-five years' experience in teaching Latin, I always had a beginning class, and I am not sure but that in all our large schools every Latin teacher should have a class of beginners. Those who confine themselves to first year's work may possible fail to secure a comprehensive idea of the sequence of their instruction, but those who teach only Cicero and Vergil, like our friend, Mr. Miller, are never satisfied with the preparation that their pupils bring to them.

Although marked vowels may soon be 'relegated to the limbo of discarded absurdities,' I am inclined to believe in their efficiency. There is discipline in accuracy. Slipshod reading, whether in English or Latin, carelessness in pronunciation, indistinct articulation are indicative of incomplete training. We should be as critical in respect to the Latin reading of pupils at the age of fifteen as we are with their English reading at the age of nine or ten. If we could only go back in our Latin pronunciation to our grand old mother tongue, all this wrangle concerning marked long vowels, and quantitative pronunciation would cease forever.

I appreciate all that has been said concerning the need and importance of professional training. The lack of it is the bane of our teachers to-day, and I see little opportunity for improvement so long as—tell it not in Gath—so long as college presidents and professors give testimonials to all their graduates who apply to them. We do not care to know whether a student has been 'faithful in his application,' 'diligent,' 'painstaking,' 'conscientious,' 'successful in scholastic attainments'; he may be all these and yet be a flat failure as a teacher. What we want to know is whether these professors, who for four years, more or less, have studied his character, noted his habits of thought, his manners, his dress, his physiognomy, are convinced that he is furnished with the equipment of the character-building, soul-inspiring teacher. It is not conscience, it is the lack of conscience that 'doth make cowards of us all.'

I am heartily in sympathy with the issuing of a Classical Journal, provided it can be made intensely, practical, of high literary merit, and largely for the benefit of secondary schools. I also hail with delight the beginning of a movement that shall bring about a six years' course of study in our high schools. It is a move in the right direction, and one which will lead to a broader culture.

PRINCIPAL F. D. SHERMAN, OF THE BAY CITY HIGH SCHOOL.

One reason for the unsatisfactory character of our Latin teaching lies in the fact that teachers feel hampered and restrained by the University requirements.

PROF. B. L. D'OOGE, OF THE STATE NORMAL SCHOOL, YPSILANTI:

I do not believe in making a hobby of this matter of pronunciation though it, too, has a disciplinary value.

How much preparatory Latin have we, who are teachers of Cæsar, Cicero, or Vergil, read? Have we read more than four books of Cæsar? If not, let us at once read all the Commentaries, and the Civil War as well. How as to Cicero and Vergil! Let us begin to-morrow to make up our deficiency in this respect.

With regard to lack of time for advanced work, I think we all have a right to claim time enough to do what we ought in this line. We are not slaves. If we give a fair amount of time to our regular school work, if we give it eight or ten hours a day no School Board has a right to say to us, 'You must give us all your time.' I think any Board, made up, as they usually are, of common sense, practical business men, would see the matter in this light, if it were fairly presented to them.

After the morning session a meeting of the classical teachers was held to arrange for a Latin and Greek conference in the spring vacation of 1895, and to consider the advisability of founding a quarterly review devoted to the interests of Latin and Greek in the secondary schools. The conference will probably last two days. Papers on the following subjects have already been promised:

"The Uses of *prin* in Xenophon;" "The *Cum*-constructions in Cæsar's Gallic War;" "The Sources of our Knowledge of the Pronunciation of Latin;" "The Influence of Vergil on the Literature of the Middle Ages;" "The Latinity of the Vulgate as Illustrating the Colloquial Latin of the Time."

Other papers will be arranged for. To facilitate the work of the conference, the following committees have been appointed:

1. Committee on Arrangements—Principal J. G. Pattengill, Ann Arbor High School; Superintendent Townsend, Marshall; Professor Kelsey.

2. Committee on High School Classical Library—Superintendent W. H. Honey, Flint; Professor B. L. D'Ooge, State Normal School; Principal Sherman, Bay City High School; Principal Warriner, Battle Creek High School.

3. Committee on Illustrative Material for Classical Teaching—Professor Kelsey; Professor Martin L. D'Ooge; Superintendent Thompson, Saginaw; Principal Garwood, Marshall High School; Miss Miner, Detroit High School.

4. Committee on Publication—Professor Kelsey, Professors A. H. Pattengill, Rolfe and Drake; Principal J. G. Pattengill, Ann Arbor High School; Principal Bliss, Detroit High School; Principal Hartwell, Kalamazoo High School; Mr. J. H. Harris, Orchard Lake Military Academy; Mr. E. L. Miller, Englewood High School, Chicago; Mr. E. C. Pierce, Saginaw High School.

THIRD SESSION—DISCUSSION OF THE REPORT OF THE COMMITTEE OF TEN.

The discussion was opened by Prof. Hinsdale, of the University, who spoke upon the report as a whole.

PROF. HINSDALE: [Abstract]* The work of the Committee in organizing the conferences and in digesting and organizing their views and recommendations is worthy of all praise. How fruitful its own positive recommendations will be, time only can tell. Their appearance has elicited a chorus of applause, not unmixed, however, with notes of criticism and dissent. Such of the Committee's views as seem to require the fullest examination will be particularized:

1. The Committee appears to have assumed that the choice of studies in secondary schools, and indeed in all general education, is measurably indifferent. Everything depends in its view upon the teacher, the method, and the time, and nothing upon the subject. The committee has accepted what Rein calls "the fiction of formal discipline" in its most exaggerated form. It is discouraging to find it lapsing into this bit of scholasticism, just as the educators of the country are beginning to emancipate themselves from the old dogma of a universal or formal discipline.

2. The Committee has elaborated four high school programmes. Such questions as these present themselves at once. Shall seven or ten periods be given to history in the classical course; or shall we, as one critic has suggested, drop formal history altogether from this course, and teach Cæsar, Cicero, and Vergil, Xenophon and Homer, so as to confer all the historical knowledge that the course calls for? Shall physics be put in the second high school year? If the subject is to be taught in that year can it be made to answer the just demands of admission to college? Shall four periods a week be given to leading subjects as a rule or shall the old practice of a period a day for such subjects be adhered to? In behalf of the new recommendation a diversified programme may be pleaded; in behalf of the old rule, concentration of study. In the three non classical courses, shall we distribute a total of 18 periods among 8 different sciences, with a maximum of three periods a week for a year and a minimum of three periods a week for a half year; or shall the work be more concentrated with suitable options?

3. The total amount of work that the programmes call for is 20 periods of 45 minutes each a week. This assignment is accompanied by two qualifications, namely, that at least five of the 20 periods shall be given to unprepared work, and that laboratory subjects should have double periods whenever that prolongation is possible. Possibly some teachers will be unable to discover where five periods of unprepared work can be advantageously given. Which of the subjects will bear it?

The question is whether the amount of work that these programmes call for can be obtained from the secondary schools of the country. It is well known that boys in the secondary schools of Germany and France do quite as much work as is here called for.

* The paper was published in the University Record for April.

It is also well known that boys trained in the schools of those countries, at the age of eighteen, are two or three years ahead of our boys of the same age. The question is whether such a regimen as that found in a German gymnasium can be generally established and maintained in our high schools and academies under existing social conditions. Is not life here too intense, too nervous, and are not boys and girls introduced to these excitements at too early an age to permit their emulating in study the boys of France and Germany? Is not the standard of education among us too low, and are not our secondary school pupils too early touched by the intensely practical spirit of American life? In respect to the amount of work that is prescribed, the Committee of Ten appears to me to have taken council of hope rather than of experience. All in all, I incline to the opinion that the Committee has done its best work in organizing the conferences and in discussing their reports, and not in providing practical working programmes for the schools. Perhaps, however, its most valuable service will prove to be its lifting the whole subject of secondary education up into the clear light of public knowledge.

President Boone, of the Normal:

I join in this discussion with genuine plea ure, partly because I am much interested in the subject, and partly because it indicates the great change that has taken place in educational matters during the last fifteen or twenty years. I have few criticisms to make on the report, and if I had many, I do not think I should make them here. The report has already been somewhat severely criticized. Perhaps the critics have acted on the assumption that this was something final. I take great pleasure in saying that nothing was farther from the thought of the members of the committee; it is all tentative, suggestive.

One point is the idea of continuity of work. I am persuaded the Committee did not mean to say—although it might be so inferred from the words of Dr. Hinsdale—that one subject is as good as another for purposes of discipline, but that any one phase of a given subject if pursued continuously for four, five, six, seven years, is as efficient in its way as another, provided it be taught in the same thorough continuous way. One weakness of the old courses of study lay in the attempt to do a little of everything. It seems to me that one blunder has been made in recommending, in addition to what is now taken, that one other foreign language be introduced in the early years of the high school and later years of the elementary course. It is not the number of languages that is valuable, but the continuity of the work done in them. Learning does not consist in the multiplicity of things known; it does consist in the consecutive deliberately planned bits of information.

History: The continuity of work in this branch is much broken.

In all courses but the English, no history is given in the second high school year; in the classical course none is given in the third year; and not much in the Latin-Scientific—about two hours, if I remember rightly—and the work is again taken up in the fourth year. I question very much the advantage of work in history which is pursued in this disconnected way. The idea of continuity should be carried out in this branch, as well as in language or mathematics. In the Latin and Latin-Scientific courses history may be taken instead of mathematics. That seems to me to be a great distortion. One phase of history may be linked with another phase, one language may be linked with another, one science may be linked with another, or one form of mathematics linked with another form, but the same kind of culture can not be gained from mathematics as can be gained from history. In allowing history to be dropped out in the fourth year nothing like it is put in its place and the benefit of continuous historical study is lost. In the classical and Latin courses about 57 per cent. of language is given. If language were taught in the secondary schools as it may be and is taught in universities, the same kind of culture would be obtained as is ordinarily obtained from the study of history; but I question whether that efficient training which makes the study of the languages a cultivation of the historical instincts is given in our high schools. If the languages are so taught we can afford to leave out history in the fourth year, but not otherwise.

Geography: I wish the spirit of the conference could have been better carried out in the report on this subject. With the exception of history, I know of nothing more fruitful in the enlargement of view of children in the elementary schools, or anywhere below the university, than geography. Yet the amount of time given to this subject is very small indeed.

The Committee were of the opinion that physics, chemistry and astronomy should not be taught differently to those who go to college and those who do not. President Eliot in his summary makes the statement that the thought of this Conference was more strongly expressed than that of the other Conferences touching that matter—that the instruction throughout the high school should be given without reference to whether the boy was going to college or not. I believe in that. Throughout the Classical and Latin courses, for example, the thought is constantly present that the boy must have certain work because he will need it in college. This I think is unfortunate. The sort of education best for the boy who drops out of school at the age of 18 is the best for the boy who goes to college. It is true he may not know so much of mathematics, so many languages, but he does know how to study. Education in the high school is not so different from that in the college; what is good for one is good for the other. The instruction should be adjusted to

the needs of the boy at the time without reference to what he is going to do after leaving the high school. When such a boy comes to the university he will, perhaps, be found to be ignorant of many things we may think he ought to know, but during the time he remains within college walls, he will be able to do far more work.

Proportion of time allotted to the various branches. It would seem that the sciences and the historical work furnish the exercise ground for the child; language comes in incidentally. Languages should be studied from the historical, or social, or constitutional side. When you get into literature, it ceases to be a study of language—you study the history of the people and in that sense it comes to be history. But, as was stated before, ordinarily we do not study language in this way in our high schools.

By comparing the recommendations of the Conferences and the report of the Committee of Ten, it will be observed that the Committee of Ten allow more of history, more of science, more of mathematics, than the Conferences call for. This is an anomaly which I have not been able to explain. This is a great concession on their part; and it is interesting because it shows how largely the colleges have been won over from the old traditional curriculum. They are willing to concede that there are phases of discipline and kinds of knowledge just as helpful as can be obtained from the old time training. It is indeed remarkable when this Committee, who are supposed to have no sympathy with the common schools, actually cut down the percentages in Greek and Latin and increase the amount of history, mathematics and science. I feel that there are grave objections to the report, but the Committee certainly have done a large service in certain movements toward a broader development of our secondary school work.

PROF. M. L. D'OOGE, OF THE UNIVERSITY:

At the meeting of the Greek Conference it was found upon comparison of views that the ideas and ideals of the members were very different. The first question that confronted the Conference was whether to look at the matter from an ideal point of view or from a practical point of view, or as a friend of mine is fond of saying, whether the question concerned a theory or a situation. I think possibly the Conference made a mistake in not asking for more than it did, and I am inclined to think that had it foreseen what treatment its recommendations were to receive at the hands of the Committee of Ten, it would have been a little less modest in its requests.

Upon a comparison of statistics with reference to the study of Greek in different parts of the country, it was found that the study was pursued in some schools six years, in others but two. There were schools in which over 1,000 recitation periods were given; in others less than 200. It was found that the average amount of time

given to the study of Greek in the representative schools of the country was 524 periods distributed over less than two and a half years. In view of this situation the Greek Conference recommended that five periods a week be given during the first year, or the second high school year, four periods during the second year, or third high school year, and four periods during the third year, or fourth high school year, making a total of thirteen periods; in all a total of 520 periods on an average of forty weeks for the school year. It will be observed that this was a little less than the amount now given on an average throughout the country. Upon consulting the recommendation in the report of the Committee of Ten, it will be found that the Committee recommends five periods in the third year and five periods in the fourth, or a total of ten periods, making in all 400, or one-fourth less time than recommended by the Conference.

This recommendation on the part of the Committee of Ten is due to two causes. First, the necessary connection between Greek and Latin—the study of Greek being subsequent to the study of Latin; second, to the fact that it was thought best that the time when the study of Greek be taken up should be postponed as late as possible. As regards this second point, permit me to read from page 45 of the Report the following: "In the first place they endeavor to postpone till the third year the grave choice between the Classical course and the Latin-Scientific. They believe that this bifurcation should occur as late as possible, since the choice between these two roads often determines for life the youth's career. Moreover, they believed that it is possible to make this important decision for a boy on good grounds, only when he has had opportunity to exhibit his quality and discover his tastes by making excursions into all the principal fields of knowledge." I wish to take some issue with this feature of the report. It seems to me that the language of the report can only mean that Greek, as Greek, is to be looked upon practically as a professional or a technical study and is not deserving of the same treatment given to Latin, for instance, as a disciplinary study. Why was it thought wise to introduce French or German one year earlier than Greek? Greek is to be taken up after the boy's tastes are proved by making excursions into all branches of knowledge. I do not consider Greek a study for all, far from it. My point is this: in the classical course the study of Greek should be begun earlier than it now is. I will state one or two reasons why I think this is vital. We all know the ease with which a foreign language is studied; it is in almost inverse ratio to the age at which it is taken up. Then why begin the study of French or German before the study of Greek? How is it in France or in the German gymnasium? The French boy begins the study of Greek at the age of twelve and continues it for five years; he begins the study of Latin at the age of eleven and continues it for

six years. The German boy begins the study of Greek at the age of twelve and carries it on for six years. The American boy begins the study of Greek at the age of sixteen and carries it on for two years in the high school. The German boy then enters the university at about nineteen years of age and has nine years of Latin and six of Greek; the French boy enters the university at the age of sixteen and has had six years of Latin and five of Greek; our American boys enter at about eighteen and a half years of age and have had four years of Latin and two of Greek. What is the remedy for this? The remedy has been intimated in two or three passages in the report; it was intimated by the statement made by President Eliot in the Educational Review. He stated that all the conferences except that on Greek found it impossible to treat the subject of secondary schools satisfactorily without asking for an improvement of elementary school programs; Greek did not go back far enough. Several studies should be begun in the elementary schools that are now begun in the secondary schools. Dr. McKenzie says: "It is an American inanity that the secondary course need not begin until the fourteenth or fifteenth year, and it follows that the recommendations of the Committee are impracticable." In other words the remedy is simply to dip down into the grammar school, making the line of division between the grammar and high school two years lower down.

PROF. J. C. ROLFE, OF THE UNIVERSITY:

I am led by the direction which the discussion took this morning to begin my remarks on the report of the Latin Conference with a few words on the subject of quantity. The high merit of Professor Kelsey's paper, and the deservedly favorable impression that it made, may cause his remarks on the subject of quantity to do much harm, especially if they be misunderstood. His theory and practice in the matter of pronunciation I know to be thoroughly in harmony with the views of the Conference. The only point on which we have a difference of opinion—an entirely amicable one—is on the use of texts with the long vowels marked.

The brightness and wit of Mr. Miller's paper should not lead us to dismiss an important subject with a laugh. Exaggerated prolonging of long syllables is nowhere recommended, and it is distinctly stated that 'the meaning of the text must not be subordinated to the sounds of the letters.'

Let us briefly consider, first:

What sort of pronunciation shall we teach? If we adopt Mr. Miller's views, and what some of the speakers this morning erroneously believed to be Professor Kelsey's views, *we should go back to English pronunciation.* If it is believed that to indicate the vowel quantities accurately is too difficult, and that too much time is given to the matter of pronunciation, that is the only honest

and pedagogically sound position to take. It is not honest to pretend to teach the Roman pronunciation and to neglect the distinction of quantity; it is not good pedagogy to do slipshod, careless work; to say to the pupil: 'Pronounce as well as you can; if it is too much trouble to learn all the quantities, never mind them.' The pupil will carry these same habits of negligence into the rest of his work. By all means, then, let us go back to the English pronunciation, if we cannot use the Roman.

I do not believe myself that such a step is necessary. The difficulties of acquiring an accurate pronunciation are great but not insuperable. A prime requisite is thorough knowledge on the part of the teacher, since the force of example is very strong.

I come then to the second part of my subject. Finding the Roman pronunciation in general use. How shall we teach it?

First by pronouncing carefully ourselves and insisting that our pupils do the same. Secondly, by furnishing them with texts of the authors to be read in the preparatory schools, in which the quantity of the vowels is indicated. Let us briefly consider the objections to such texts which were offered in the paper of the morning.

1. It was said that they are unnecessary. To this I cannot agree. The subject is too difficult to be taught in a single year. Moreover, pupils can be held more strictly to account when they have a marked text before them, and unfortunately most teachers in our secondary schools cannot read accurately without such texts.

2. They are said to be detrimental, because they teach the pupil to walk with a crutch when he should walk alone. If this idea is carried out to the full, we should put into the pupil's hands a text of Cæsar, and Harper's Lexicon, and let him make his way by himself. Crutches of various kinds are necessary, special vocabularies, notes which reiterate instruction on points of syntax and translation, illustrative material of all sorts, all of which are found in Professor Kelsey's own excellent series of text-books.

3. The marks of quantity disfigure the page. This is indeed true to some extent, but is largely a matter of habit. The same criticism could be made regarding the Greek accents, if they were to be introduced into our texts to-day for the first time.

4. The marking of texts is said to be pedagogically unsound, since it teaches dogmatically what is really a matter of uncertainty. It is true that regarding a number of the 'hidden quantities' the best authorities disagree. It seems to me that in such cases we should follow our standard lexicon, since there is good evidence on both sides, and not make marked texts a medium for ventilating our individual theories. The number of doubtful cases is comparatively small, the standard lexicons are not likely to be revised oftener than once in ten or a dozen years, and the few changes which revision makes necessary can be introduced without risk of great confusion.

Other good points of the Report, which might be enlarged on are the suggestions regarding translation at hearing, the plea for better English in translation, the recommendation of a qualitative rather than a quantitative requirement for admission to college.

Prof. Barbour:

One or two questions have been put to me concerning our report, which I will answer at once: 'How are pupils to acquire any literary style without special work in composition, which shall consist in exercises showing their ability to write?' This question has reference, probably, to the following statement in the report: 'The Conference doubts the wisdom of requiring, for admission to college, set essays (e. g. on the books prescribed, as above, Sec. 1) essays whose chief purpose is to test the pupil's ability to write English. It believes that there are serious theoretical and practical objections to estimating a student's power to write a language on the basis of a theme composed not for the sake of expounding something that he knows or thinks, but merely for the sake of showing his ability to write.'

One of the most entertaining and profitable discussions at our Conference was that by Professor Kittredge of Harvard University, based upon results of examination of students entering Harvard When students were required to write 'set essays' they crammed in their reading of the prescribed books, sat down to write upon a subject that they might have no interest in, were embarrassed by the consciousness that every word and phase would be looked upon as evidence of *their ability to write.* He submitted that this is not a fair test, that the attitude of mind is wholly unfavorable to the student's best effort. None of us would be willing that our style, our power of expressing thought, should be judged by essays written under such circumstances.

It was in agreement with this opinion, advanced by Professor Kittredge, that the Conference recommended that the entrance examination tests in English should be, not necessarily 'set essays,' but *questions* on topics of literary history or criticism, testing the student's knowledge of 'the political, social, intellectual and religious development of the English race; questions so framed as to require answers of some length, thus testing ability to methodize knowledge and to write clearly and concisely.'

In the discussion of the work below the high school, it was recommended that the writing of narratives and descriptions begin in the third school year; that the difficulty of the subjects assigned be gradually increased. That this work be varied by the pupils writing of their own experiences and observations—on subjects drawn from topics of interest to child life. It is impossible to limit the topics for composition work to any particular subjects; they should be drawn from everything that interests and touches the lives

of our youth; whatever they can *talk* about with interest and intelligence, that is a fit theme for written composition.

Perhaps the most important suggestion of the conference, in reference to work below the high school, is the subordination of formal instruction in English grammar, and exercises in false syntax, to the reading of good literature and constant practice in composition. The fact that the study of technical grammar does not contribute directly to the pupil's power of expression, was admitted by all. It was thought that grammar, so much as is necessary, might be taught very largely in connection with literature and composition, and that apart from such instruction three hours a week in the eighth grade would be sufficient for all formal grammar.

In high school courses, formal rhetoric is looked upon in its relation to literature and composition, very much as grammar below the high school in its relation to reading and composition. Although a course in elementary rhetoric is recommended, 40 hours is considered sufficient for such formal instruction. The conference clearly expressed its opinion that rhetoric may be taught best in connection with literature and composition; that it is not to be studied in the high school by itself, or for its own sake.

In conclusion, I should like to repeat what I said yesterday. Mr. Samuel Thurber and others were positive in their conviction that the poor English of our schools is largely due to the lack of co-operation of all teachers in secondary schools in their oversight of good English expression. I have heard nothing at this meeting so disheartening to me as the suggestion that a teacher of physics should be tolerated, who is not a judge of correct English, and that the teacher of physics, for instance, cannot be expected to share in the responsibility of securing good English.

Prof. Scott:

Mr. Barbour, in his reference to yesterday's conference on English, has given, I fear, a wrong impression of my views. If I understand him, he has represented me as saying that I think a teacher of other subjects than English may very properly be deficient in English scholarship. I am sure I did not express that opinion in my paper. I deplore such deficiencies as much as does Prof. Barbour. The problem, however, is how to deal with the present state of affairs. Are our principals and superintendents ready to dismiss fine teachers of physics who may happen to be deficient in their English?

Prof. Barbour:

I wish to state that my remarks had no reference to Prof. Scott's paper.

Mr. Miller:

I believe my views are the ones Mr. Barbour has misrepresented. I had determined to say nothing about the matter, how-

ever, because I was pleased at the clearness with which he made his point, and I wished to do nothing to deprive him of the credit of making it.

I heartily agree with Mr. Barbour's statement that there should be active co operation between all teachers in the matter of securing good English. But with Prof. Scott I believe, and believe most firmly, that there can be no systematic work unless one teacher be at the head of this work, able to take charge of it in a scientific and workmanship-like manner. Our ordinary science teachers have no time to do this. The science teachers in my school work until six o'clock many times, preparing material for the next day's work. It is not right to put upon them anything more.

MR. J. O. REED, OF THE UNIVERSITY :

I wish to rise in behalf of teachers of physics. I think teachers of physics can, and do, use fully as good English, use it as intelligibly as those who make a specialty of this work. They are just as capable of getting out of the language what is meant to be conveyed and of expressing themselves clearly as any class of people. I am willing that the teacher mentioned pass as an example to be avoided, but I protest against the view that the average teacher of physics is of that character.

LETTER FROM PRESIDENT ANGELL.

ANN ARBOR, March 26, 1894.

Professor B. L. D'Ooge, President of the Schoolmasters' Club :

DEAR SIR:—I regret very much that I cannot be present at the next meeting of the club. I had made an engagement to give an address at the University of Toronto on next Friday, before I knew that the Club was to meet on that day. I should have been glad to accept the invitation of the Committee to take part in the discussion of the report of the Committee of Ten.

But as I cannot be present at the meeting, I should like by this note to call the attention of the Club to a few points, on which I think there is some misapprehension.

1. The Committee in presenting Table IV did not regard that as the best possible course for all high schools, but rather as one of many schemes, which might be made with some differences in detail, out of the material furnished by the preceding tables. The Committee supposed that even if in a general way their suggestions were followed, high schools would naturally adapt their courses to their peculiar conditions. The scheme in Table IV was intended as a sample rather than as a model to be strictly followed everywhere.

2. Being familiar with the Michigan High School schemes, I was not favorable to the plan adopted of suggesting twenty periods

a week. But the Eastern men were strongly in favor of it, because their schools generally take as many periods as that. But twenty periods were taken with the understanding that at least five of the periods should be given to work for which no preparation is required, such work, for instance, as drawing, music, elocution, and sight reading of foreign tongues. It is the custom of the schools in the East to follow such a plan.

3. The Committee in framing Table IV. did have distinctly in mind the wisdom of securing continuity in studies, and did also have much discussion on the educational value of studies. But probably no ten men could thoroughly agree in making a table embodying their views on these subjects. Agreement could only be had by compromise. There was strong difference of opinion concerning the placing of physics in the second, rather than in the third or the fourth year. Those who favored teaching it in the second year did so on the ground that a very large proportion of pupils leave the High School by the end of the second year, that they ought to have some scientific work of value, that physics on the whole furnishes more knowledge of practical value to such persons than any other science, and that it can be taught at that time in such a way as to be of service to them. There was unanimity in the desire to avoid teaching any subject for so brief a time as to secure only scrappy training in it. How well the committee succeeded in carrying out these ideas the public will judge. No table could be made which some members of the Committee would not criticise.

4. And finally, I think I do not misrepresent the Committee when I say that they did not flatter themselves that their work would be accepted without criticism, but that they did hope that it would awaken intelligent and earnest discussion through the country. They did hope that such discussion of the specific suggestions they have made by teachers who had carefully studied the very valuable reports of the special conferences, would arouse fresh interest in the problems of secondary education, and lead ultimately to the great improvement of our high schools and academies. There are most gratifying indications that their expectation was well founded.

Yours very truly, *James B. Angell.*

NOTE.—Line 5, p. 42, should read: "If a vowel, naturally short, is followed by a mute and a liquid, etc."

Mr. Miller's paper is published by permission of the Michigan *Moderator*, in which it will also appear.

PROCEEDINGS

OF THE MICHIGAN SCHOOLMASTERS' CLUB AT THE THIRTY-FIRST MEETING HELD IN ANN ARBOR NOVEMBER 25-26 1898

UNIVERSITY OF MICHIGAN 1837

Ann Arbor
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1899

Supplement to the University News-Letter

MICHIGAN SCHOOLMASTERS' CLUB.

PROCEEDINGS OF THE THIRTY-FIRST MEETING, HELD AT ANN ARBOR, NOVEMBER 25-26, 1898.

SECRETARY'S MINUTES.

SESSION OF FRIDAY AFTERNOON.

The club assembled in the auditorium of the Ann Arbor School of Music and was called to order at 2:15 by President Warriner.

D. W. Springer of Ann Arbor was introduced and read a paper entitled, Commercial Courses in the High School. The discussion was opened by Carl C. Marshall, Battle Creek, editor of *Learning by Doing*; and was continued by Principal S. O. Hartwell, Kalamazoo; Superintendent M. R. Parmelee, Charlotte; Superintendent J. F. Rieman, Monroe; Professor B. A. Hinsdale, Ann Arbor; and Superintendent L. S. Norton, Jackson. The points especially emphasized in the general discussion were the length of the commercial course, the desirability of making it as thorough as the other courses of the high school, the modern languages demanded by the times, and the utilitarian value of commercial education.

Owing to the unavoidable detention of Superintendent David MacKenzie, the presentation of his paper was postponed, and Superintendent W. C. Skinner, of the Toledo Manual Training School, was called upon to discuss Manual Training in the High School. The subject aroused an animated discussion in which George Carman, principal of Lewis Institute, Chicago, Professor B. A. Hinsdale, C. C. Marshall, E. C. Goddard of the University, and others took part.

SESSION OF FRIDAY EVENING.

The address of the evening was made by Professor B. A. Hinsdale of the University of Michigan, who took for his subject, The End of Education: It it Knowledge, Development, or Social Adaptation? The paper was discussed at some length by Professor H. C. Adams of the University of Michigan, after which the members of the club and their friends met one another in an informal way.

SESSION OF SATURDAY MORNING.

The first paper of the morning was read by R. G. Boone, president of the Michigan State Normal College, upon the subject, The Professional Training of High School Teachers. The discussion was opened by A. J. Volland, principal of the central high school, Grand Rapids. President James B. Angell of the University, and Professor B. L. D'Ooge of the State Normal College expressed their views upon the subject.

The business session was opened with a discussion of the Club's relation to the *School Review*. Dissatisfaction seemed to be felt with regard to the present method of publishing the proceedings, owing to the expense and delay. Treasurer L. S. Norton made a statement of the financial condition of the Club. A letter from H. R. Pattengill, editor of the *Moderator*, was

read by the secretary, in which an offer was made to publish promptly all proceedings of the Club in either one or two issues and to supply these to members at ten cents a copy. It was moved by Professor B. A. Hinsdale and supported by Superintendent H. M. Slauson, that the question of publication be referred to the Executive Committee, with power, and that for the consideration of the question Professor F. N. Scott be added to the Committee. After some discussion the motion carried. It was moved by Professor J. O. Reed, Principal A. J. Volland supporting, that the one dollar fee be returned to; and this motion was carried.

Through Professor B. L. D'Ooge and President R. G. Boone an invitation was extended to the Club to hold its spring meeting with the State Normal College, at Ypsilanti. Moved by Superintendent J. F. Rieman and supported by Superintendent M. R. Parmelee, that the invitation be accepted. An amendment was offered by Professor J. O. Reed, supported by Superintendent H. M. Slauson, referring the place of meeting to the Executive Committee. Principal A. J. Volland moved that the matter be decided by the Club itself, and that the amendment be tabled. This motion was seconded by Professor E. O. Lyman and was carried. The original motion that the spring meeting be held in Ypsilanti was then put and carried.

After a few minutes intermission Superintendent David MacKenzie, Muskegon, read a paper entitled, Manual Training in the High School. The Round Table discussions followed under the leaders: Principal G. W. Peavy of Flint, Literary and Debating Societies; Principal C. E. Holmes of Lansing, Athletics; Principal J. H. Harris of Bay City, Marking Systems and Grades of Diplomas; Principal W. D. Baker of Battle Creek, Rhetorical Exercises.

The Club was adjourned by the President at one o'clock Saturday, November 26. The attendance upon the various sessions ranged from 75 to 125.

W. H. Sherzer, Secretary.

PAPERS AND DISCUSSIONS.

THE END OF EDUCATION: IS IT KNOWLEDGE, MENTAL DEVELOPMENT, OR SOCIAL ADAPTATION?

ABSTRACT OF A PAPER READ BY PROFESSOR B. A. HINSDALE, UNIVERSITY OF MICHIGAN.

For three hundred years at least, there have been two unmistakable tendencies in educational theory and practice. Some teachers seek to furnish the intellect of the student with a store of positive knowledge, while others wish to develop and improve the intelligence itself. The one class, to appropriate M. Compayré's words, are occupied only with the instruction which takes place through what is without, through an extended erudition, through an accumulation of knowledges; the other class conceive instruction as taking place, as it were, through what is within, through the development of the internal qualities of precision and measure. These two tendencies the French author calls the objective and the subjective pedagogies, and associates them with the names of Lord Bacon and Descartes. They are very natural tendencies, and are emphasized by somewhat different classes of persons. Teachers, and the public generally, tend to emphasize positive attainments, philosophers and teachers of the classical languages and literatures tend rather to emphasize mental development. But the objective and subjective pedagogists

do not exhaust the subject. A third group of men find the end of education in its uses. There is the old story of Agesilaus, King of Sparta, who, caring nothing for knowledge as such, or for mental cultivation, said a boy should be taught the things that would be useful to him when he became a man. This theory, which is extremely congenial to some minds, has a lower and a higher form. The lower form is on a level with the bread-and-butter sciences, the higher form clothes itself in the language of philosophy, especially, perhaps one may say, of sociology. This third tendency leads to what may be called the teleological pedagogy. It finds the end of education in character and activity. The teacher should strive, so it is held, not primarily to furnish the pupil with knowledge or to develop his mind, but primarily to adjust him to the world or to the civilization in the midst of which he lives. This is the conception of education expressed by Herbert Spencer in the well-known definition found in his work on education,—"to prepare us for complete living is the function which education has to discharge, and the only rational mode of judging any educational course is to judge in what degree it discharges such function." The Committee of Fifteen that drew up the report on the Correlation of Studies in Elementary Schools, committed itself unreservedly to the teleological pedagogy.

Having defined these different tendencies of thought, Professor Hinsdale proceeded to discuss their relations, reaching in general the conclusion that the real question at issue is more one of emphasis than of positive difference. If knowledge is acquired in the best way, it will lead to mental development. On the other hand, mental development can not be obtained except through the attainment of knowledge. Neither one is an exact measure of the other, and neither one can be separated from the other. What is more, if the knowledge pursued is the best knowledge, and if the mind is developed in the best way, what better preparation for the duties of practical life can the child have? In other words, any one of the three ends set forth, if intelligently pursued, will involve both the others. Practically, then, the question is not so important as it may be made to appear.

Professor Hinsdale closed with quoting a brief speech that he had contributed to a discussion of the general subject two or three years before at one of the annual meetings of the Superintendents' Section of the National Educational Association, as follows:

"The lines of battle are drawn here this morning much as they have been drawn on previous fields of discussion. It is contended, on the one hand, that the proper point of view from which to survey the child's education is that of the available culture-material. It is insisted, on the other hand, that such point is the nature of the child. Participants in the discussion emphasize respectively environment and psychology. 'The course of study is of prime importance,' some say; 'psychological analysis of the child mind is what we want,' others reply. I cannot think the issue is so sharp or so important as the contestants appear to think.

"Education is the growth, expansion, or development of the mind through its own activity. Hence the mind is a fundamental fact to be considered. But the mind acts, and so grows, only when brought into relation with objects capable of stimulating it to activity, and so to growth. Hence objects of knowledge - what we may call culture-material or education-stuff—is also a fundamental fact in education. The process that we call education may therefore be examined on either side, viz.: the nature to be educated and the material or stuff to be used in educating it. There is an adaptation of the

external world to the nature and needs of the mind; there is an equal adaptation of the human development, or of civilization, to the same nature and needs. To deny this last proposition is to deny that the civilizations of the foremost nations are psychological; it is rather to affirm that they are not genuine manifestations of man's nature but are parasitic growths. Hence the two points of view are correlatives, and to omit either one is to commit a mistake. Nearly the whole field, if not all of it, can be seen from either point of observation. If Dr. Harris and Dr. De Garmo were to sit down at a table and draw up a course of study they would not materially disagree, save, perhaps, in the reasons that they might assign for their respective recommendations. For instance, Dr Harris would urge the study of geography because it is forced upon the child by his environment; Dr. De Garmo would urge its study because it is adapted to the development of his mind. Neither one, I feel sure, would wish to deny the validity of the other's reason. Accordingly, I appear on the field in an irenical spirit, and plead not for a compromise but for a broader view."

THE PROFESSIONAL TRAINING OF HIGH SCHOOL TEACHERS.

BY PRESIDENT R. G. BOONE, MICHIGAN STATE NORMAL COLLEGE.

Mr. Nightingale of Chicago read a paper upon this subject before the Schoolmasters' Club, November 1895, which was published in Vol. IV of the *School Review*, page 129, March 1896. It was then called a "hackneyed subject," but described as one which must, in the interests of the schools and because of a lingering public sentiment, be perennially discussed. True, the question is one that has been discussed, not indeed from time immemorial, but throughout much of the professional life of the oldest teacher, perhaps, present. Ten years, however, will cover the more active and thoughtful and public discussion of the question. In Poole's Index, the leading current reference to periodical literature, no mention is made of either high school or secondary teachers as to their training prior to 1887. Most of the serious and more scholarly discussions of the questions have occurred within the last five years. The Cleveland Cumulative Index has, up to the present time, made no reference to the professional training of high school teachers; nor the American Library Index to General Literature.

The subject has however had abundant discussion, sometimes scattering, often unintelligent, in gatherings of school people; which has had its effect, in affording material for criticism and further discussion, in arousing not only the professional but the lay interest, in revealing both strength and weakness, unexpected in high school teaching, and in a slow but obvious adjustment of professional opinion upon the question.

The organization of the Department of Secondary Education in the National Association, dates, I think, from 1887. The interests of the high school and of other preparatory schools were given attention prior to that upon the general programme of the Association, or by the standing committee on higher education in the National Council. In 1891, at Toronto, Mr. Frank E. Plummer, who was president of the Secondary Section of the N. E. A., read a presidential address on the "Future High School," in a paragraph of which upon the high school teacher, he included among the characteristics demanded by the time, "a thorough understanding of the art of teaching."

Two years later, during the meeting at Chicago, Professor E. P. Hughes of Cambridge, England, read a paper upon "Professional Training for Teachers of Secondary Schools," and outlined the practice course followed by the Teachers' College. The year following, Mr. C. P. Lynch, referring to the editorial introduction by Dr. Harris to the Report of the Committee of Ten, that, "It has been agreed on all hands that the most defective part of our education is that of the secondary schools," characterized the deficiencies of high school work as arising from, (1) an inferiority of equipment, and (2) an inferiority of teaching ability.

What has appeared in the progress since 1894 is recent history, is quite as familiar to most of you as to the speaker, and need not be recounted here.

In the Report of the Committee of Ten, a single brief paragraph only is given to the qualifications of Secondary Teachers, aside from the references made to this by several of the conferences. From the wording of the introduction to the report, concerning the admitted need for more "highly trained" teachers for these schools, it is evident that what was in mind was that they should be more scholarly. The Conference on the Modern Foreign Languages averred that the worst obstacle to the progress of modern language teaching is the lack of properly equipped instructors. The conference on the physical sciences reported their conviction that it was yet impossible to provide suitable instruction in elementary science even, without specially trained students in science. But there is no indication there either in the text or the context that a science teacher has need for other qualifications than to be a scientist.

Of all the conferences, that upon history and political science only, gave deliverance to a clear conviction of the necessity of something more than a knowledge of history for efficient history teaching. They urged that the subject must be presented by teachers who not only have a fondness for historical study, but who have paid attention to effective methods of imparting instruction, as the same committee elsewhere phrases it "a knowledge of illuminating methods of teaching history."

In the Report of the Committee of Fifteen upon elementary schools and education far more space and attention were given to the qualifications and training of secondary teachers than in that of the Committee of Ten, which had reference technically to secondary schools; which only emphasizes the often reiterated statement that at that time the training of secondary teachers had not yet become a burning question. This later report urges that as one-sixth of the teaching body in the United States are secondary teachers or superintendents; and that as from the students of the high schools come our social and business leaders, the superintendents, village principals, and practically all of our elementary teachers, "secondary teachers should be trained even more carefully than elementary teachers are trained." And, in a very general way, a course of study is arranged and submitted for the training of such high school teachers.

Sixty years ago, in his famous Massachusetts Report for 1839, Horace Mann quoted from the just published Fifth Report of the Glasgow Educational Society's Normal Seminary as follows:

"There is perhaps no mistake so fatal to the proper education and training of youth as the practical error of imagining that because a man possesses knowledge therefore he will be able to communicate it. The knowledge of a Newton or a Bacon avails little with an improper mode of communicating it."

The really encouraging fact to the discussions of secondary teachers of

the past is the large and growing interest shown in questions touching the order and the distribution of the work, actual and comparative values of studies, the varying aims of education at successive stages of a child's life, the conditions of highest returns in study, and economy of effort on the part of both student and teacher. These, obviously, are not academic questions at all. One may be a scholar with all the dignities that pertain to vast learning and well-earned honors, and yet have given these matters little or no serious attention. Such questions have been often discussed and in both scholarly and helpful ways. The consideration of these could not long continue among serious minded men and women having the interests of secondary schools at heart, and the conviction *not* follow that their meanings will be really apparent to those only who have been trained to supplement their academic insights with these and similar pedagogical interpretations.

A long list of subjects might be selected from recent discussions touching secondary school work, generally professional, and very helpful. "Aims and Methods in the Study of Literature," "The American in History," "Reading for Teachers in the High School," "Tendencies of Secondary Science Teaching," "What Should the Modern Secondary School Aim to Accomplish?" "What Studies should Predominate in Secondary Schools?" "Comparison of American and European Secondary Schools," "German Methods in Secondary Schools," "Equipment of the High School Teacher in France, "Reform of Secondary Education in the United States," "Secondary Education in European States," "French and American Secondary School Programmes," "High School Programmes without Greek," "What Constitutes a High School?" "Order and Relation of Studies in High School Courses," "The School Curriculum in its Relation to Business Life," "Secondary Schools and Co-ordination of Studies," "Correlation of Science work in Secondary Schools," "The Curriculum of Small High Schools," "Values in Secondary Education," "The Principle and Practice of Election in High School Courses," "Tendencies in Secondary Education," "High School Work and Adolescence," and "Research as the Vital Spirit of Teaching," are secondary school questions, none of which bear directly upon the question under present consideration; but all of which through twenty-five years have made easier the way to a sound and liberal conception of the professional training of secondary teachers. For their intelligent treatment there are needed teachers who are familiar with the forces that make for civilization, the directing of them, and the conditions of social and personal thrift and vigor; the aims and conditions of individual maturing also, and the insights that make study inviting to the youth and promotive of the highest spiritual health; teachers who are leaders, conscious and purposeful, far-seeing, resourceful, students who know the way to student interests and know how to inspire others.

As a result of all this discussion, perhaps, I venture to think that the concensus of opinion may be fairly summarized as follows:

(1) In general, teaching should be prepared for as should any other practice involving scholarly ability.

(2) There is no less need for this special training to supplement scholarship among high school teachers, than among elementary teachers.

(3) The professional training for high school teachers should follow or accompany the later years of a fairly liberal general culture.

(4) What is meant by "professional training" comprises more than a study of educational doctrine or its history. There is implied both critical observations of good teaching, that is consciously and purposely good, and

teaching accompanied, followed by more or less frequent, and always expert criticism.

I. That school people and, more or less, the general public are questioning about the preparing of teachers in a professional way for the advanced and preparatory classes in secondary and collegiate schools, implies a somewhat widespread recognition not only of a possible need, but of the possibility of meeting that need. It seems scarcely to be required in this presence to argue further for the need. The very general interest in, and use of the high school, have dignified its work, and have led to a great multiplication of its exercises, to increased equipments and expenditures, and to the substitution of new and far less utilitarian aims than formerly. The more rational ends of elementary education discover their natural sequence in the humanizing and socializing and moralizing and culturing not less than the industrializing purposes of the high school. Better teachers are needed in the high schools to handle wisely the improved product of the elementary schools; as better teaching must soon be demanded in the colleges and universities, to harmonize with the more reasonable conceptions of the means and ends of education and teaching, in the better secondary schools. It is a wholesome sign that people are interested in the work and results of these schools; that they have strong opinions about them, and widely different opinions; that the discussion springs up anew perennially, begun now by laymen, and now by professionals; that occasionally there are found in each group some who are willing to listen to the other; concessions are made; very general and sometimes unimportant conclusions are accepted and formulated; and the sky is clearing. Teachers should comprehend the matter better than others. The right will be conceded when the claim has been justified. In the meantime there is a growing belief that the work of the high school is of an order that requires high art, and that some of the fundamentals of the art may be communicated and the principles that make it rational. Existing schools of pedagogy and the interests of the colleges and universities in the curicula and teaching and the product of these schools, are a pledge of the public's confidence that the teaching is worth improving and that a way may be found. Opinions differ as to the right way, or the best way, but both the way and clear vision will come with a well-conserved interest.

II. Let it be said then, speaking somewhat more in detail, but still broadly, that high school teachers have need, first of a sensible and comprehensive knowledge of the growth of the science they undertake to teach. That the mathematician, for example, who aspires to be a teacher also, has made himself familiar with the development of the several phases of his subject, the emphasis now put upon algebra or arithmetic, and again upon geometry, and why; the parts of each that have survived and those that have dropped out as factors in elementary and secondary education, and why; the sequence of topics and their respective values among different people and at different periods; the respect that has been, through the years, accorded the several parts of the subject, and the whole subject among others in the curriculum, argues a fitness for teaching mathematics that no breadth or depth of mathematical learning, as such, can guarantee. The best teaching of high school English today—either its grammar or literature—is weak in quality and narrow in scope, except the current possession be re enforced by a strong perspective of its development. The teaching of either is undertaken with a double risk by one who knows no language but English and who sees in the literature of the past and in the current creations, no interests and purposes of the race strug-

gling for expression; groping, now in darkness, now in the dawn; now leading the life, now following haltingly and subdued. To fail in this insight is to fail in understanding the youth's slow maturing, and the concealed and often unintelligible aspirations and unequal appreciations of literature and the values of artistic and effective expression, by which he comes to an intelligent appreciation of their content, and a mastery of their forms. The same is not less, perhaps more true, of the evolution of the sciences, and of history as a science. With the ends of education what they are recognized to be, no one can handle any knowledge to much profit as a school instrument who is unfamiliar with its determining antecedents, and the conditions that have given it present form. Science as an instrument of training is not a fixed and unchanging factor, but mobile and becoming, virile and aggressive; and is a fruitful instrument to this end, only when so employed. Secondary teachers have need to be very familiar with the beginnings and important stages and present dynamics of their several subjects, and the social and professional and economic conditions that have furthered the development.

III. This implies that they habitually discriminate in their teaching between the present organization of this current science and its empirical order. There are dangerous extremes as well as wholesome truth in the dictum of Spencer that "the order of development of the faculties in the individual is the same as the order of development in the race;" with the implication that the subject matter which was suited to the race during primitive stages should be employed by teachers with children in corresponding stages of development. It does seem to be true, however, that the order of experience is vastly superior to the logical order as an instrument of education through the elementary phases of whatever subject. Below the university the empirical order is the effective order for teaching; though it is a quality of large scholarship to hold and use knowledge deductively. This may explain in part why it so often happens that great scholars teach badly. They fail to remember the stages in which they came to their now familiar convictions and wide knowledge. But this constitutes a professional view of one's subject, and the ability to adapt one's abundant knowledge of a science, whether more or less complete, to the needs of a mind growing in and by these experiences goes far to make one a teacher. The secondary teacher has need to know his subject in its making, and not hold it statically as so much possession. Scholarship includes the latter; it may or may not include the former. The professional training of the secondary teacher should include the latter in abundance, it must, to be effective, include the former.

IV. Again, secondary school teachers have need to know, somewhat familiarly, the stages and factors in the general history of culture, the conditions of improvement and deterioration, social and personal, and the success of attempts to use the various institutional means for education and training. Among the several nations and in different ages, what has succeeded and what failed? What of permanent value had each for us; and for western civilization? Under what social and personal virtues have people survived, and to what end? For it is that the social group, the institution and the large interests that conserve and further human achievement may survive to worthy ends, that all our teaching is done, mathematics and the sciences, technics, mechanics, and the formularies, not less than history and the train of the humanities. The teacher in secondary not less than elementary schools finds his instruction both liberalized and made specific, whatever be the branch taught, and he sees more clearly the way and the means by which the present civilization has been

achieved; among all the products—human and material, personal and public, what really has seemed worth while; what has justified itself, in the doing or the having; what educational and economic values our own experts may safely expect to attach to the traditional means and the customary devices. The increased acceptance of this view appears in (1) the larger and less wooden interests in historical studies, and in the wholesomeness of institutional life as related to the means and environments of culture; (2) the serious and scholarly attention given in recent years, to investigation into the origin and growth and influences of the universities, colleges and other superior institutions, including academies and the entire group of secondary schools; and (3) the very recent interest in tracing the beginnings and development and the increased employment of the present subjects of our secondary courses, as means of education.

Each of these has had frequent attention in recent years in very helpful papers and before this Club, or published in the technical and general periodicals of the day, showing an attempt to discover and properly organize the true work of the secondary school. From President Eliot's "Current Tendencies of Secondary Education," through a study of "Values in Secondary Education," "German Methods" in these schools, "The Differentiation of High Schools," "Self-Government," and "Electives" in high schools, and the relation of the secondary system to the parts above and below it, to the Report of the Committee of Ten and the voluminous literature that has followed it, there is revealed a rich field in historical and critical studies in secondary education whose cultivation must yield rich harvests to the intending teacher. Then there are the more detailed investigations in narrower lines—such as "English Work in High Schools," the "History of English-German Teaching," and the "Educational Value of English;" "Methods in Teaching Secondary Latin;" the "Educational Value of the Method of Science Teaching;" the "Educational and Industrial Value of Science;" "Natural Science in a Literary Education;" the "Humanistic Element in Science;" "Fundamentals in History;" "History as a Factor in Secondary Education;" and the "Educational Value of History;" "The Place of Modern Foreign Languages in Secondary Education," etc. If the questions above need to be answered for the good of the school, intending teachers have need of a training that shall fit them for wise answers. What with our groping and experimenting, sometimes succeeding, sometimes failing, we should see to it that those who succeed us as preceptors and instructors of the youth to come shall be equipped for fewer failures and a surer foresight.

V. But whatever the plea here means, or does not mean, there should be little difference of opinion among us upon the statement that a study of the history and the theory alone of secondary education, will not make one a teacher; any more than a study of the contributing sciences alone will be adequate to the training of physicians, or a study of social and property rights would be sufficient for the lawyer. The teacher has a right to his practice training as has the doctor to his clinic or the lawyer to his moot court; and the secondary teacher not less than the mistress of the grades. The colleges and the universities, and superior normal schools of the country, must accept the charge of certificating from their halls for such positions those only who have:

(1) An abundant scholarship, from two to four years in advance of the academic work they undertake.

(2) A sympathetic, but critical and philosophical mastery of the current educational doctrine. And

(3) An assured resourcefulness and effectiveness before a class, that gives promise of their being able really to help, in a large way, not hinder the progress of their students.

THE PROFESSIONAL TRAINING OF HIGH SCHOOL TEACHERS.

BY PRINCIPAL A. J. VOLLAND, GRAND RAPIDS.

At a recent meeting, the State Council of Superintendents of New York favored a resolution urging the passage of a law which shall prevent the appointment, in that state, after May 1, 1899, of teachers in high schools who are not graduates of colleges or universities approved by the Regents of the University of New York. And the following significant requirement was added: "That all such applicants shall have had at least one year's study in a recognized school of pedagogy or two years' teaching experience in high schools or three in elementary grades." Here, then, are distinctly recognized two qualifications for the high school teacher, namely, scholarship and pedagogical training.

It seems unnecessary to discuss the almost axiomatic statement that no teacher should be employed in a high school who is not a graduate of the literary department of a college of repute. And the statement is just as true whether the high school prepares for college or not. Those who are seeking an education in our secondary schools should have the benefit of the most competent teacher, regardless of whether that school is the last of their student life or is but the opening door to the more advanced life of a college. A broad scholarship gained from years at a college is an essential characteristic of such a competent teacher. And this scholarship should be broad, not narrowed by specialization in the early years of college work. The college student should widen his horizon in language, history, mathematics and science, should come in touch with the world of knowledge. Whatever special line of work our student is intending to pursue in after years as a teacher, he must be able to draw his illustrations freely, intelligently, from all life, for in the high school, he will not be teaching specialists. As a teacher, he will have before him a wide range of receptivity and of adaptability in the many young minds in his classes and unless his illustrations are drawn from all life and accomplishment, his efforts will be halting and unsuccessful. Language, science, mathematics and history are all handmaids to the specialist and to disdain their help, to pretend to despise them is but to prove one's own narrowness and to dwarf one's teaching capacity. I have known several complete failures among high school teachers because of this lack of breadth of horizon. These teachers failed to appreciate that their special line of work was connected with the different work of other teachers. And yet, I would not exalt knowledge too high, for wisdom is higher still. Wisdom is common sense, and without common sense all our acquired knowledge is but a tinkling cymbal. But with common sense, the educated man is well equipped for even the profession of teaching, though he is better equipped if he has a knowledge of the laws of the mind and of methods of teaching, and also has the ability to apply these methods intelligently and fruitfully.

This leads us then to the pedagogical side of the topic. Those New York superintendents emphasized the necessity for technical training in the high school teacher and said it could be gained in two ways, one by attending a re-

cognized school of pedagogy, the other by actual teaching experience either in high schools or in elementary grades.

A teacher untrained in his profession is as much of an absurdity as an untrained doctor and is capable of even as much mischief. Permit me to show from some experience in high school work in what important ways a college-bred man makes mistakes in teaching when he is not acquainted with psychologic and pedagogic truths. First: The high school teacher just from college will be likely to use college methods in his work, he will instruct rather than teach. Second: In his ignorance of the psychologic truth that the mind grows by its self-activity, our untrained teacher thinks his pupils know much because he has told them much. The third mistake naturally follows in that he has deprived his pupils of the right of discovery, deprived them of that incentive for further work. "Eureka!" the philosopher cried, and the joy of discovery is the right of every student. Fourth: His language, when he should talk with accuracy, clearness, and concreteness, is not adapted to the mentality of his pupils. He talks over their heads both in respect to the content of the words he uses and the fitness of his illustrations. Fifth: The details of attention on the part of his pupils, their order and deportment, escape him. These points may be largely overlooked in college but are not wisely so even in a large high school. Sixth: Our inexperienced teacher with no training in methods blunders lamentably in his presentation of subjects. He has no method of teaching, no methods of attack, naturally belonging to the subject in hand. He has not learned *what* is to be done as a teacher, *why* it is to be done and *how* it is to be done. This must mean a blundering, aimless recitation. He does not know how the mind acts and what is the best way of presenting objects of knowledge so as to lead to their comprehension in the easiest and yet most valuable manner. And once more, he does not know the educational value of the subjects he is to teach, does not know for instance, the purpose to be aimed at in the study of geometry or history or language.

Many other illustrations of pedagogical mistakes made by college graduates not professionally trained, might be given, but here are enough to show the need in a high school teacher of some pedagogic training in addition to the knowledge qualifications first discussed. Without a comprehension of the principles on which good teaching is based, the teacher becomes either a mere imitator or a teacher without definite purposes and well-considered means for accomplishing these purposes. Common sense leads many teachers to teach correctly,—common sense instructed by experience. But there are many left whom the work in a pedagogical school would benefit. A year in such a school concentrates the truths of many lives and experiences, changes his mental attitude so that he no longer considers knowledge from the point of view of the student merely but also from that of the teacher. And it seems to me that the theory of the science of education should be accompanied by the practice of the art of education. The man who is learning to teach will learn most by teaching under intelligent supervision.

Concluding, I would say that in my opinion, the professional qualifications of high school teachers should be: First, The general or broad scholarship gained in a college literary course; second, The specialization in such work as they desire to emphasize; third, An intelligent acquaintance with psychologic knowledge derived from history, philosophy and experience; fourth, A fund of tested methods based on psychology intelligently formulated from experience under supervision.

A young person so equipped and strengthened by common sense, tact and sympathy will succeed as a teacher in any school, and will be well qualified for the work of a high school teacher.

COMMERCIAL COURSES IN THE HIGH SCHOOL.

[The following courses of study for high school commercial departments or commercial high schools were submitted to the club at the Friday afternoon session as bases for discussion.]

I.

PREPARED BY DURAND W. SPRINGER, B. S., DIRECTOR COMMERCIAL DEPARTMENT, HIGH SCHOOL, ANN ARBOR.

FIRST YEAR.

FIRST SEMESTER.	
German, Spanish or French,	5
Algebra,	5
U. S. History,	5
English,	**5**
SECOND SEMESTER.	
German, Spanish or French,	5
Commercial Arithmetic,	5
Modern History,	5
Correspondence and Penmanship,	**5**

SECOND YEAR.

FIRST SEMESTER.	
German, Spanish or French,	5
Algebra,	5
Physical, Commercial and Industrial Geography,	5
Freehand and Instrumental Drawing,	**3**
English,	**2**
SECOND SEMESTER.	
German, Spanish or French,	5
Bookkeeping,	5
Botany or Biology,	5
Typewriting,	**3**
English,	**2**

THIRD YEAR.

FIRST SEMESTER.	
German, Spanish or French,	4
Accounting,	4
Civil Government,	5
Chemistry,	4
English,	**3**
SECOND SEMESTER.	
German, Spanish or French,	4
Office Work, and Customs and Methods of Business,	**4**
Com'l Law, and Nat'l and Foreign Com'l Legislation,	5
Industrial Chemistry,	4
English,	**3**

FOURTH YEAR.

FIRST SEMESTER.	
German, Spanish or French,	4
Physics,	4
History of Commerce and Industries,	4
Geometry,	5
American Literature,	**3**
SECOND SEMESTER.	
German, Spanish or French,	4
Physics,	4
Economics,	4
Study of Products and Fabrics,	4
English Literature,	5

REMARKS.—1. The above outline presupposes a study of Business Forms, and enough of Bookkeeping to enable one to keep a private cash account, in the eighth grade.

2. The figures to the right indicate the number of recitation periods per week.

3. Black-faced figures indicate that the lessons should not require extended outside work.

4. Stenography may be substituted for any ten hours' work. No credit for the study of a foreign language should be given unless it has been pursued at least two years. If, therefore, stenography is substituted for one year of a language, but one foreign language can be taken.

5. Each student should be required to devote at least three hours a week to systematic physical development and one hour a week to acquiring the art of public speaking.

II.

PREPARED BY CARL C. MARSHALL, EDITOR OF *Learning by Doing*, BATTLE CREEK.

FIRST YEAR.	FIRST SEMESTER. Writing (free arm) Elementary Bookkeeping and Office Practice English (Grammar Review with Business Correspondence) and Spelling History of American Government and Politics SECOND SEMESTER. Commercial Arithmetic Bookkeeping and Office Practice English (Circular Letters, Business Announcements, with Proof Reading, Printing Office Requirements, etc.) Elements of Business Law	THIRD YEAR.	FIRST SEMESTER. English History Elements of Algebra Elementary Economics German or Spanish SECOND SEMESTER. Economics Elementary Geometry Study of Products and Industries Elementary Physics Spanish or German
SECOND YEAR.	FIRST SEMESTER. Stenography and Typewriting Business Law Government (Municipal and State) Transportation and Commerce SECOND SEMESTER. Stenography and Typewriting Corporations and Corporation Accounting History of Commerce and Industries Ethics as applied to Business and Commerce Elements of Rhetoric, Preparation of Themes, etc.	FOURTH YEAR.	FIRST SEMESTER. Inorganic Chemistry American Literature Industrial Drawing and Ornamentation Spanish or German SECOND SEMESTER. Organic Chemistry with Biology Banking and Finance and Advanced Accountancy Sociology Spanish or German

MANUAL TRAINING IN THE HIGH SCHOOL.

SECOND PART OF A PAPER READ BY SUPERINTENDENT DAVID MACKENZIE, MUSKEGON.

[The first part of the paper—a careful discussion of certain theoretical aspects of the question—is omitted for lack of space.—EDITOR.]

EQUIPMENT.—Although manual training is as essential a part of an elementary as of a secondary school curriculum, its introduction into the latter presents so few difficulties as compared with its introduction into the former, that the first year of the high school is, perhaps, best suited as a starting point from which the subject can be extended later, as conditions will permit, into the grades below and above this.

A complete manual training high school will have three departments, that

of the mechanic arts, that of the domestic arts, and that of drawing. The mechanic arts will require five shops,—the joinery, the pattern shop, the foundry, the smith and the machine shops. The domestic department will have a kitchen, a dining-room, a laundry, one or two sewing-rooms and a nursery. In the drawing department there will be separate rooms for freehand and mechanical drawing, and for modeling, or such other phases of the work as the course may include. In addition there will be a gymnasium for the boys and also for the girls, and the various store rooms, class rooms, and usual facilities required in a modern school building. In most communities, the expense of such a building and equipment makes its immediate realization an impossibility. But the absence of a special building is not a bar to the introduction of manual training into high schools. The ordinary class room will suffice for the plain sewing; a session room containing a floor space of 1,200 feet will serve for a kitchen, while a well-lighted basement room with a floor space of not less than 1,600 feet will meet the requirements for the joinery, or of 2,400 square feet where the joinery and the pattern shop are to be combined. A building having three such rooms for utilization, contains accommodations for two years of manual training in domestic and mechanic lines. If more room than this is obtainable, it can, of course be used advantageously. But expensive buildings and lavish equipments, although characteristic of many manual training schools that owe their existence to private beneficence, are in no sense a necessity, and not even desirable educationally or industrially. Indeed, it seems to be the prevailing opinion among those familiar with the subject of manual training, that the matter of necessary space and equipment has been greatly exaggerated, and the wiser policy is to begin on a moderate and unpretentious basis and enlarge with the natural growth of the work. Furthermore, each school should build up an individuality of its own, determined largely by its particular conditions and environment. With each year, slight modifications may seem desirable, so that it is better to begin modestly, and equip gradually and according to the actual necessities of the school. In determining this matter, it is to be remembered that each work-room can be occupied by four sets of pupils each day, the manual training day including four periods of one and one-half hours each. The number of pupils to the class should not exceed twenty, although in first and second year work it may safely reach twenty-four, if necessary. Thus each workroom provides accommodations each day for eighty pupils.

A fair estimate of what may be regarded as a reasonable equipment for a high school beginning manual training under these conditions, would be:

First and second years:

1. Joinery (1st year joinery and carving).—

10 Double Benches at $15	$ 150 00	
20 sets Bench tools at $10	200 00	
20 sets Carving tools at $5	100 00	
Tool-room equipment	50 00	$ 500 00
Later it will be found advisable to provide for a more complete equipment which will include a circular saw, a planer, and a grindstone, which may be estimated at	$ 250 00	
Shafting, Belting, etc.	100 00	$ 350 00

2. The Pattern-shop (2nd year—turning and pattern-making).—

10 Lathes at $45	$ 450 00	
20 sets bench tools at $10	200 00	
Benches	100 00	
Tool-room	50 00	
Shafting, Belting, etc.	200 00—	$1000 00
To this outfit should be added as soon as possible: a pattern-maker's lathe, band-saw, trimmer, and grindstone, estimated at		200 00
Total		$1200 00

3. The Kitchen.—The most important item in connection with the kitchen is the plumbing, but unless the conditions are unusual, the expense of fitting up and equipping need not exceed $500. This will include kitchen-desks with gas and water connections, a coal and a gas range, and individual and class dishes and utensils for classes of twenty pupils each.

4. The Sewing Room.—The expense of this room is very small, as sewing-tables and chairs constitute its chief articles of furniture. As the sewing advances into garment and dress-making, draughting tables and sewing machines must be added.

5. Drawing Rooms.—In most of our high schools there is always a more or less extended course in drawing or in art. In such schools, all that would be necessary would be its adjustment and correlation with the manual training. For the first year or two the drawing-room work might be carried on in the ordinary class or session rooms when special drawing rooms are not provided, but as soon as possible, specially fitted drawing rooms should be provided with suitable light, and with tables, easels, models, casts, and studies. Such an equipment may be estimated at from $250 to $500.

6. Lavatories.—Unless the building is a modern one, with a large and convenient lavatory, provision will have to be made for at least one lavatory for the shop. Lavatories and lockers constitute an important item in a manual training school, both in respect to ease and successful administration. It is desirable that each shop and work-room have its own lavatory and lockers, or that at least a separate lavatory be provided for every two shops; but as this is an item pertaining rather to the building than to the manual training equipment, and as it offers such a wide margin in style and construction, it is difficult to give an estimate of its cost. Perhaps $500 may be taken as an average estimate of the cost of a lavatory containing twenty basins and one hundred lockers.

7. Power.—The question of power will be determined largely by local conditions and individual preferences, but does not require consideration until the school is ready for the lathes. In our own school we have adopted electric power, and for the two wood-working shops have a 15-horse-power motor costing, complete, about $500.

Although these suggestions and estimates are given on the supposition that provision is to be made for but two years work, it will not be amiss to add estimates for the shop equipment for third and fourth years.

Third-year Shops:

1. Foundry—		
Cupola, core-oven, brass furnace, ladles, crucibles, etc.	$300 00	
Foundry tools, scale, etc.	150 00	
Benches..	100 00	—$ 550 00
2. Smith-shop—		
20 Forges and connections	300 00	
Fan, blower and connections	150 00	
Installation	150 00	
Tools	500 00	—$1100 00
3. Motors for the above shops (complete)		400 00
Total		$2050 00

Fourth-year Machine Shop:

Ten lathes at $200	$2000 00	
Planer, shaper, drill and milling machine and installation	1000 00	
Tools, benches	500 00	—$3500 00

THE CURRICULUM.—The lack of time and the difficulty of adding to an already crowded curriculum are, next to cost, probably the chief deterrent factors to the introduction of manual training in our high schools. But, as has been shown, manual training is not necessarily unreasonably expensive, and will in this respect compare favorably with the equipment of scientific laboratories, which are a part nowadays of even the smaller high schools. It will be found, too, on trial that actually, as well as theoretically, handwork, although adding somewhat to the length of a pupil's hours per week, easily compensates for this by contributing in a marked degree to his mental power and capacity for his academic studies. In the typical manual training school the time given to hand-work and to academic class work is the same, but this proportion will not be found suited to the average high school pupil. In Muskegon, where manual training has been tried for two years, pupils having special aptitudes for industrial work divide their school-day nearly equally between manual and academic work; while others, whether in high school or in college preparatory courses, devote only about one-fourth of their school-day to manual work. Whether or not this proportion will be continued throughout the entire four-year course, will be determined by results as we shall see them. Of a total of four and one-half hours a week given to the manual work by academic pupils, one and one-half hours are spent in two lessons in the drawing rooms and three hours in two lessons in the shops or work-rooms.

COST OF MATERIAL AND OF MAINTENANCE.—The cost of the material used by pupils is very small under economic management and is paid for by the pupils themselves by materials fees. Our aim is to make the fees charged just balance our expenditures for materials. The fees charged at present, which is the only expense connected with attendance at the school, are, for resident pupils:

1. *Mechanic Arts Department.*
   a. Mechanical courses (one year, 5 lessons per week), each per year .... $ 50
   b. Academic courses (one year, 2 lessons per week), each per year 25

2. *Domestic Department.*

   a. Sewing and dressmaking, all courses each per year......... 25

   b. Cookery:

   (1) Domestic courses (2 lessons per week), each per year. 2 00

   (2) Academic courses (1 lesson per week), each per year.. 1 00

   (3) Housekeepers' class (15 lessons).................. 5 00

   c. Laundry (when a separate course)........................ 25

3. *Drawing Department.*

   All courses (1 year) each.................................. 25

Cost of Instruction.—Salaries will average higher here than in the high school, as the demand for thoroughly successful teachers in both the mechanic and the domestic arts exceeds the supply. In considering this question, it should be remembered also, that most of this work, like laboratory work in a high school, requires vacant periods during the day for preparation so that a teacher cannot always conduct the full number of four classes a day, if normal manual training periods are in vogue. Salaries for the different departments may be estimated at $800 to $1,200 for the mechanic arts, $700 to $1,000 for the domestic arts and science, and $700 to $1,000 for drawing. In our own school which has an enrollment of over 500, with three heads of departments and four assistants, the salary roll is about $650 per month.

Instructors.—The promised results of manual training are not dependent upon or commensurate with an expensive plant or lavish equipment but the personality and character of the teachers. For whether manual training will be simply one more time-consuming subject in an already crowded curriculum or whether it will be a unifying element in the course of study contributing to the fullest development of the intellect, the sensibilities and the will, and to the realization of the spiritual ideal, will depend upon the attitude of the teacher toward his work. A mere workman or even a clever artisan, however skillful in the use of tools, can never secure higher than economic and industrial results. Nor is the situation always much improved by the employment of graduates of technical and professional schools; for too often their teaching is only a repetition of the erroneous teaching of the schools, in which formal instruction takes the place of self-training and development. Their pupils may attain surprising technical skill and intellectual and aesthetic appreciation, but they will not gain in self-direction, in human interest or in spiritual insight. To technical knowledge and skill must be added a study of pedagogics, and above all an insight into and sympathy with the ethical and spiritual, as well as educational value and aim of manual training, which will elevate and transform manual labor in the home and in the shop from drudgery to pleasurable activity, and make of the servant and of the laboring man profitable and progressive factors in the industrial and social world.

PRINCIPALS' ROUND TABLE.

MARKING SYSTEMS AND GRADES OF DIPLOMAS.

Principal J. H. Harris, Bay City:—Four systems of marking are in vogue: (1) The numerical system; (2) the word system—excellent, good, fair, poor, etc.; (3) the letter system—A, B, C, D, etc.; (4) the passing or open system, where pupils are marked simply *passed* or *not-passed*. But since the last three systems reduce themselves ultimately to a numerical judgment

in a more or less concious degree, the preference for one or another must rest on the question of the relative value of what may be styled the open *versus* the close system of grading, *i. e.* systems 1–3 *versus* system 4. Since the fundamental and original function of the marking system is to give outward and visible expression to a subjective judgment of the mental attainments and possibilities of a pupil, the open system is undoubtedly the sounder and more rational, for it is founded upon a basis which will last through life, whereas the close systems are artificial and temporary. But although the original purpose of the marking system is to estimate the pupil's powers, there are certain legitimate concomitants of it too important to be overlooked. These are the stimulation of friendly rivalry, the improvement of the general tone of scholarship, and especially the cultivation of what may be termed school public opinion, *i. e.*, a feeling of pride before one's classmates in successful and creditable performance. These objects are secured by the artificial stimulus of the close system; they are not directly fostered by the open system. The conclusion may be drawn that where the educational and moral tone of the community is of a sufficiently advanced character to rest on the broader and more logical grounds, where the children are from progressive and cultured homes where high ideas prevail, the simple feelings of pride and shame, admiration and respect of schoolmates, and the like, will be found to be adequate motives, and the mere record of *passed* or *not-passed*, or *conditioned* will be found to satisfy all the ends for which the marking system exists. But where the community has not reached a high stage of intelligence, where low ideas prevail in both the home and the community, the artificial stimulus becomes necessary, and the close system will meet certain ends which cannot be met in any other way. In most schools the conditions are not yet ripe for the simplest and most rational method of marking. For the present, therefore, teachers must gradually work toward the second and third methods, which are in the nature of compromises and stepping-stones.

RHETORICAL EXERCISES.

PRINCIPAL W. D. BAKER, Battle Creek:—There should be some field wherein the pupil of special capacity for public speaking may exercise his talent. This already exists in the form of rhetorical exercises in schools, and in local, district and state oratorical contests. The work in this field is at present being creditably done and arouses a great deal of interest.

There should also be a strong effort made on the part of teachers to remove the difficulty that many pupils experience in fluently and audibly expressing themselves. This matter is not receiving sufficient attention. The training needed is doubtless best secured, not by recitations of set pieces but by short talks on topics of current interest and by debates. Superintendents and principals of small high schools can do the work by resolving their schools into literary societies on a Friday afternoon. In the larger schools, the problem may be solved by securing co-operation of assistant teachers or by organizing into societies those who are especially interested in this line of work.

PROCEEDINGS

OF THE MICHIGAN SCHOOLMASTERS' CLUB AT THE THIRTY-SECOND MEETING HELD IN YPSILANTI MARCH 31 AND APRIL 1, 1899

Ann Arbor
University of Michi
1899

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MICHIGAN SCHOOLMASTERS' CLUB.

PROCEEDINGS OF THE THIRTY-SECOND MEETING, HELD AT YPSILANTI, MARCH 31 AND APRIL 1, 1899.

SECRETARY'S MINUTES.

THE FRIDAY SESSIONS.

The thirty-second meeting of the Michigan Schoolmasters' Club was called to order by the President, Mr. E. C. Warriner, at 9 o'clock, Friday morning, March 31, 1899. The Classical Conference had been in session on the previous afternoon, but the sessions of the Club proper did not begin until the time above stated. President Warriner, after announcing the opening of the session, invited Professor B. L. D'Ooge of Ypsilanti to act as Chairman for the morning. Professor D'Ooge therefore took the chair and introduced Professor Thomas D. Seymour of Yale University, who gave to a large audience a lecture on A Midsummer Trip to The Lands of Hellas, accompanied by stereopticon views.

At the close of the lecture President Warriner resumed the chair. A motion that the President appoint a committee of three on nominations to report at the business session on Saturday was carried, and the President announced that he would report the names of the committee at the close of the morning session.

The next topic for the morning being then taken up, Professor C. O. Hoyt of the Michigan State Normal College read a paper on The Period of Adolescence. The discussion of this paper was led by Superintendent S. B. Laird of Lansing. At the close of Mr. Laird's discussion, President Warriner announced the following committee on nominations: Professor J. H. Drake, chairman; Professor E. A. Lyman, and Principal S. O. Hartwell. The Club then adjourned for the morning. The afternoon was given up to conferences of various kinds, as announced in the programme. These were all largely attended and the interest in them was keen.

In the evening Normal Hall was again filled to hear the address of Superintendent L. H. Jones of Cleveland on Higher Ideals in Education. At the close of the lecture a reception was tendered the Club and its visitors by the Faculty of the Normal College, in the Gymnasium.

THE SATURDAY SESSION.

The general session of the Club was resumed at 9:30 Saturday morning, April 1, President Warriner in the chair. The first paper of the morning was by Professor George Hempl of the University of Michigan, upon the subject, Should the College Course be Shortened to Three Years? Other papers on the same subject were read by Professor F. W. Kelsey, and by ex-Regent Levi L. Barbour of Detroit. A short recess was then taken. After the recess the business session was called to order, and the report of the nominating committee, appointed on the previous day, was called for and given by Professor Drake, chairman of the committee. The following officers were nominated for the ensuing year: President, W. H. Sherzer of Ypsilanti;

Vice-President, E. T. Austin of Owosso; Secretary, J. H. Harris of Bay City; Treasurer, R. S. Garwood of Marshall; Members of Executive Committee, E. O. Marsh of Jackson and Professor A. C. McLaughlin of Ann Arbor. On motion, the report of the nominating committee was accepted and approved, and the officers, as nominated, were declared elected.

The question of the publication of the proceedings of the Schoolmasters' Club was then taken up, and Professor F. N. Scott explained the arrangement that had been made with the Board of Regents for the publication of the proceedings in the *University News-Letter*. The Board of Regents had agreed to appropriate seventy dollars for this purpose, the Schoolmasters' Club to appropriate the balance necessary. On motion, it was voted to appropriate thirty dollars from the Club funds for the publication of the proceedings as a supplement to the *News-Letter*.

Superintendent S. B. Laird then introduced the following resolution, which was unanimously adopted;

WHEREAS, There is now pending before the legislature of the State of Michigan a bill which has for its purpose a change in the organization of the public school system of the city of Detroit; therefore be it

Resolved, By the Michigan Schoolmasters' Club in convention assembled, that we heartiiy indorse said measure as being calculated to advance in the best way the educational interests of the state; and be it further

Resolved, That we urge upon the members of the legislature the passage of said bill.

Bibliographic Instruction in the High School was the subject of the closing paper of the session, read by Mr. B. A. Finney, Assistant in the General Library of the University, and discussed by Librarian H. M. Utley of Detroit.

At the close of the discussion, the Club adjourned to meet at Ann Arbor in the Fall.

J. H. HARRIS, Secretary.

THE HIGHER IDEALS IN EDUCATION.

EXTRACTS FROM AN ADDRESS BY SUPERINTENDENT L. H. JONES OF CLEVELAND.

In the profession of teaching we are liable to an error in the discussion of principles. A single principle, projected to the front and emphasized beyond its worth by some eccentric thinker, seems so absurd that we perhaps reject it from our ideal of education without due consideration. The failure to see its relation to other spiritual forces and its necessity as their correlate leads to its rejection. A broader view would perhaps discover its necessary relation to other educational principles and suggest its value in a final correlation of the educational influences which produce the best development of the individual.

Life, for which we educate, is complex, million-sided; hence the process by which a mind is prepared to live well is likely to be somewhat complex, too. Our profession requires clear thinking and sound judgment, not only among those who direct its general processes but scarcely less in those who carry out the detailed work of the school room. There is a fascination about educational studies which easily leads us to be one-sided. One person becomes absorbed in the contemplation of education as a science; another equally so in some one branch of the curriculum, to the practical exclusion of more general considerations.

It is a notable moment in the professional progress of a teacher when he fully comprehends that the subject-matter assigned to him is a mere means, to be used for the purpose of directing most forcefully the life-development of

his pupils. Instead of weakening his interest in these branches, this view deepens such interest, and leads him to ponder well the relations of his subject to this life-development—leads him to view his subject as a causative agent at work, rather than as a dry compend of facts to be learned.

Every detail of the busiest day of the teacher in any grade is profoundly influenced by his ideals of life and of education. We can not if we would, we doubtless would not if we could, free ourselves from the overpowering influence of ideals. The ideal is the only universal force, since it alone affects self-active, self-conscious and self-directive beings. They in turn control the universe.

I have said that an ideal consists of a trinity of attributes; that it is law, guide and inspirer. In the first form—as law—it acts somewhat blindly; that is, without the intelligent co-operation of its subject. In such a case it is the creation of a superior intellect imposed in the form of law of development upon an inferior. The theory of evolution has aided modern scientific research by its discovery of the ideal of the Creator, operating in the physical world as law of development. God's ideal is present in the world as a living force, controlling dead matter, and shaping it after a pattern unknown to the world itself. The teacher who imposes his own ideals upon a pupil in the form of law, not illuminated with intelligence, touched with emotion, tempered with sympathy, treats him as dead matter rather than a living soul. He fails also to mark the difference between matter and spirit; for only when he transplants within the child the germ of an ideal of his own so that it may develop with the child's development, grow with his growth, and remain as a living force within him after the teacher's power is withdrawn, does he recognize either the true nature of the child as a spiritual being, or of the nature of the ideal as guide and inspiration.

In the world ideal as controlled by thinking there are represented four classes of thinking, standing for four classes of people. The first class is composed of people who have not passed beyond the childish stage of thinking. They are interested in *things*. Each object, whether it is a material thing or a spiritual fact, seems to these people an independent existence. They are chiefly interested in noting its characteristics. The childish stage of curiosity which leads a child after he has played with his toy until he is tired of it to take it to pieces to see what is within it, is the highest view of this grade of thinking, because it does *begin* to search somewhat for relationship of cause and effect.

The second class of thinkers perceive quite fully that *things* are not more important than their *relations*,—indeed that in some instances the relations are the more important matters. The interest of such persons grows as important relations manifest themselves in the study of things. It is a great increase in intelligence to see that activities exist as causal relations, and to discover the laws of the operations of natural forces. A glimpse at the orderly movements of the forces of nature is thus given and the elements of a science of the world are seen. But this grade of thinking never rises to a true self-active cause. It rests its conclusions on contingency—some things happen to get into conjunction—this establishes causative relations—these generate or liberate forces, and these move the stars in their courses and keep the world spinning on its axis. Similar reasoning in the moral and social world sees psychical phenomena in action and reaction. It records results, systematizes facts and develops the first stages of science; but it leaves all questions of true causation still unsettled.

The third grade of thinking makes a distinct advance. It holds the same interest in things as the first and sets a like value upon relations with the second. But it makes a definite effort to see causes and to find unities. It discovers that beyond the movement of things in their relations, there must be a power which gives law to the contending forces and limits results. People have given various names to this Power. It has been called the great Unknown. Others have called it persistent force. Outside the series of things and forces, stands this persistent force, the protector and supporter of the individual forces and processes of the moral and physical worlds—explaining them all, but needing an explanation for itself more than they needed it. It is the highest conclusion that can be reached by any process of reasoning which takes into account the external world as the chief element of existence.

The fourth and highest grade of thinking sees the futility of seeking an explanation of the universe externally. It begins its investigation with the self. The investigator must so examine himself as to be able to discover three characteristic attributes of spirit, viz., self-activity, self-consciousness, and self-direction. If one cannot find the elements of these in himself, he need never seek for them elsewhere. By the necessary study of one's self there is little difficulty in finding that one does, actually, of his own will, *begin* to do things; that is, he originates activity—becomes the source of activity in response to an *inner impulse*, instead of a mere piece of matter responsive to *environment*. One who does not find himself thus doing things does not have a very true conception of self-activity. He must come, in this way, to experience it in himself,—an act which begins without other influence than the self offers. This view is necessary to make this discovery develop the elements of self-consciousness; that is, one thus begins to discover his own thoughts, his own feelings, and his own choice; he marks the difference between thought and feeling, and the relationship of these to choice. The very process of discovering these differences and of separating thoughts from feelings, and both these from choice, is a process of classification brought on through a beginning of self-consciousness, since it is a classification through the study of one's self. The analysis thus begun may be carried into individual detail, but the nature of the process is always that just described. These two processes: that of self activity and self consciousness, make it possible to discover higher and lower orders of human experience and thus to lay the foundation for the setting up of ideals of conduct. So soon as this has been done the person has started on a course of self-direction; that is, the setting up of ideals of conduct, and the controlling of his own energies toward the realization of these ideals, although in so doing he may be obliged to withstand the influences of environment. The proper blending of these processes of self-activity, self-consciousness and self-direction, lays the foundation of human progress. The power of self-direction raised from mere expedience to the worthiness of moral conduct, marks the dividing line between mere intelligence and the moral capacity of the human being. This blending of the three makes it possible that a person may take advantage of the experience of others, deeming it of worth or value to his own life. In this way the individual, without having to live through it, secures the experience of the race. Given an infinite universe, and a being capable of experiencing all within himself, there is implied an infinite time; thus is the individual immortal. On this foundation philosophy joins with religion in asserting the immortality of the individual, personal soul.

From this study of one's self as an original force—self-active, self-conscious, and self-directive—one soon perceives that the great power which stands behind the forces of the universe, being necessarily self-active, must itself be of the nature of mind. You have only to think self-activity infinite, self-consciousness without limitation, and self-direction without interference, to have a conception of the Omnipotent, Omniscient Creator. Such a being exhibits complete harmony of intelligence, sensibility, and will, the perfect blending of these three activities into one, the dominant one being the will. Religion and philosophy again support each other, in the belief in a personal God, who is essential mind, infinite in the three characteristic attributes of spirit. His constant presence in the universe as a thinking, feeling, creating force is the explanation of its continued existence. With Him the ideal was perfect from the beginning; but the successive stages of its realization occur in time as a process of development. The theory of evolution seems at last to have discovered at least some hints as to this method in the physical world. Students of social questions are earnestly seeking to find a similar law or method of development in the province of morals. Historians have sought to learn through the deeds of men the law of race and national progress —the student of education strives to find the law of individual development and the correlation of this with the larger movements of nations, peoples, and races. This is the largest problem of all,--the others being mere conditions of the solution.

This view of the universe I believe to be the only secure foundation for a rational system of education. It gives dignity to teacher and pupil, and sets up an end or ideal of education which commands the respect of all. The individual immortality of the soul, the presence in the universe of a personal God in sympathy with struggling men, the finite human made in the image of the infinite Divine, God's ideal the law of progress,--these being given, a philosophy of education is possible.

BIBLIOGRAPHY IN THE HIGH SCHOOL COURSE.

BY B. A. FINNEY, UNIVERSITY OF MICHIGAN LIBRARY.

In connection with the increased use of libraries and of books other than text-books as tools in the regular school work, the need of some instruction that may help the pupils in the use of these tools has during the last few years forced itself quite strongly upon the attention of teachers and librarians.

At the meeting of this club in Ann Arbor in November, 1897, when Principal J. H. Harris of Bay City presented a scheme for a full high school course with considerable latitude in options, I suggested the advisability of including at least a limited or elementary study of bibliography in the curriculum[1]. By the term bibliography in that connection I referred more particularly to the acquirement of a practical acquaintance with the ordinary indexes, reference-books, etc. The history of books, of writing, etc., and the details of library science were not included in the suggestion.

The discussion turned upon the subject of high school libraries in general, and a committee, of which Mr. Harris is chairman, was appointed

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[1]See discussion on the paper on Elective Work, read by Principal W. H. Smith of Pontiac, at this same meeting, in November, 1897, and reported in the *School Review*, 7:239 (April, 1899). Mr. Harris' paper appeared in the *School Review* for October, 1898.

to secure information as to the present resources of the various high schools in the state in the way of books desirable for reference use in the several courses of study. The committee has been continued and has the matter still under consideration.

Instruction of a bibliographic character seems to have begun where its need was most pressingly felt—in the universities and colleges. It is generally conceded that the earliest regular instruction was the course begun in 1879 by Mr. Davis, librarian of the University of Michigan, and continued successfully as an elective study. It is a one-hour course of lectures given in the first semester. Courses in bibliography are now given in several of the universities and colleges: Bowdoin, Brown, University of Colorado, Illinois, Nebraska, McGill University and others.

Instruction of this kind has taken a sudden start in the Normal schools, and is making rapid headway. At the Chautauqua meeting of the American Library Association last July a report on instruction in the use of reference-books in Normal and preparatory schools was presented by Miss Adams, librarian of the Plainfield (N. J.) public library. Out of twenty schools nine report individual or informal instruction by the librarian or heads of departments, and five do special work, although it does not appear to be part of the curriculum. Miss Schreiber, teacher of literature in the Milwaukee Normal school, presents a course called "Literature and Library reading," designed to train teachers to carry on the work in the common schools. In this course the seniors have some actual work in the library, even taking entire charge of it for a few days. They learn to help others in the use of books.

A recent statement by Miss Louise Jones, of the State Normal school at Emporia, Kansas, is as follows:

Regular and systematic instruction in library methods is now and is to be hereafter a part of the student's equipment for the profession of teaching, to the end that he may the more wisely look after the interests of the library in the village or city where he may teach. Miss Simpson, librarian of the Normal school at Stevens Point, Wis., writes me of her intention to do some work of this kind there. I also understand that there is something done in the Normal College here. I believe some cataloguing is undertaken in connection with the training school, and that some of the daily work in the library is freely done by students for the benefit of the experience which they get.

At the meeting of the Library Department of the National Educational Association at Washington last year, the committee on the Relations of Libraries and Schools presented a preliminary report. Among other questions recommended for the consideration of the committee, if continued, were these:

How to encourage normal schools to give more instruction in the use of books and libraries.

How to induce high schools, colleges and universities to establish "schools of the book."

This committee was continued and hopes to present at the next meeting of the National Educational Association as full and complete a report as possible. All teachers or librarians interested in the subject and willing to contribute reports of practical experience or opinions as to method are requested to communicate with the chairman, Mr. J. C. Dana, Librarian Public Library, Springfield, Mass.

As to bibliographic instruction and reference-work in the high schools a very interesting and complete report was presented at the last meeting of the American Library Association by Miss Rathbone, of the Pratt Institute Free Library, Brooklyn. Out of thirty of the large high schools of the country fifteen report systematic instruction. Some of the instruction seems to be uncertain, and that number should probably be reduced.

In the Pratt Institute high school this work has been carried on successfully for several years, particularly by the departments of English and history.

At the annual meeting of the Michigan Library Association at Bay City, last October, I gave a paper on this subject, and in order to procure more specific information before the meeting I sent circulars to about twenty school superintendents in Michigan asking the following questions:

1. Is there any systematic instruction in the use of reference-books or any other bibliographic instruction given in your high school.
2. If so, is it a regular part of the curriculum, and what is its general character.
3. How long has the instruction been given, and how much time given to it.
4. By whom given, principal, teacher, or librarian.

The replies, which came generally from the principals of the high schools, indicated that with one or two exceptions, there is no systematic instruction, but that more or less is given in an individual and occasional way by the teachers, especially of the English and history departments, and by the librarians. A report that was stimulating was received from Principal Marsh of Jackson, who stated that there was some regular instruction given in the lower grades, although not in the high school.

A most encouraging report was received from Detroit. Principal Bliss reported that in addition to the three regular talks each semester on the use of the library, undertaken by the librarian, a systematic use of the reference-books is made in connection with the instruction in history, rhetoric and literature. They have in the Central High School fifty copies of Webster's International Dictionary, three copies of the Century Dictionary and Encyclopædia, six sets of Johnson's Cyclopædia, and an abundant supply of other books for reference work. Many of these I believe come from the Public Library as a sort of permanent loan.

Miss Hopkins, librarian of the Central High School, proposes to give three talks to the school by grades and classes, somewhat as follows:

1. An explanation of the system on which the library is classified, that they might grasp the idea of classification in general and the necessity of system, and that the numbers which they so frequently copy might come to have an intelligent meaning.
2. On indexes, general and special. (She claims that pupils are very slow to learn the use of an index).
3. On dictionaries, cyclopædias and other reference-books.

At the Ann Arbor High School, Miss Loving, the librarian, had for several years desired to do something of this kind, but had not found opportunity. I expected to give a course there last year, but it was unavoidably postponed, and this spring Superintendent Slauson has made arrangement whereby I am giving a short course of four or five lectures or informal talks to a portion of the history classes. The arrangement with the history teachers is that the pupils may elect to report on my lectures instead of some assigned reading. About seventy-five or eighty pupils have come into the class, mainly from the two classes in general history, which is second year work, although there are

some seniors from the class in English history. The course so far has developed some interest, and might be considered moderately satisfactory. Although at present much condensed, the course would be divided into about ten parts, as follows:

1. Books and writing materials in ancient times. History of the book, its form, manufacture, use and preservation, up to the time of the invention of printing.
2. The printed book. What was it? How made? Binding, etc. Care of the book. Development of the book of today. Some of the tendencies in bookmaking.
3. Libraries and the housing of books. Some great collections. Classification and arrangement of books. Responsibilities of libraries and readers.
4. The catalogue. Printed in book form, manuscript sheets, cards, etc. Different kinds of catalogues. Basis of arrangement, meaning of terms, abbreviations, etc.
5. What is a reference-book? Dictionaries and encyclopedias. Special features. Why and when one or another is to be preferred.
6. Dictionaries of special subjects, as: Biography, Mythology, Quotations, Authors, Anonyms and Pseudonyms, etc.
7. Indexes to periodical and other literature, general and special, concordances, bibliographies, etc. Theory of indexing. General principles.
8. Geographies, gazetteers, atlases and guide-books.
9. The Bible: Versions, introductions, concordances, commentaries, histories.
10. Almanacs and other annuals; census and statistical records; state and government documents; legislative and parliamentary manuals. Some final remarks on habits and method of reading.

This course is thus arranged as a series of from five to ten lectures of one hour per week, but it might be lengthened to advantage by the addition of practical work in the use of the reference-books, and reports upon them, so as to make a one-hour course for a semester.

The first-half-year of the high school course as proposed by Mr. Harris consists of only fourteen hours, while the other half-years require from seventeen to eighteen hours each. If such a course as this were incorporated into the first year's work, it would naturally be made a little more elementary, but not necessarily less useful. An advanced course, for another year, might also be given, should it seem to be demanded. Experience seems to show that wherever instruction of this kind has been tried, while relieving the teacher and librarian from many personal calls for assistance, it has at the same time facilitated the student's work in his other studies. This result would probably and directly make amends for any study or portion of a course that might be eliminated to let in the bibliography.

We must not fail to recognize on all sides that science is progressive. The librarianship of today is a science developed during the last twenty years. The title of school*master* only expresses the condition of an age that is gone. The teacher is more than an instructor; the librarian is more than a custodian. Both are educators, and are working together for the good of the public. But the methods in the use of books which have become necessary today are throwing on the shoulders of both teacher and librarian burdens too heavy to bear, and which also impede the progress of the student. Much of this would be remedied by such instruction as I have suggested. It might be given by

librarian or teacher, as the case might be, and would vary, of course, with the different conditions of teacher and pupils, and with the book resources of the school.

I would therefore advocate the introduction of bibliography, or the science of books, into the high school course for the following reasons: 1. It would relieve the teacher from a good deal of personal assistance, which is a growing demand, and the need of which is a hindrance to the progress of the work. 2. It would relieve the librarian from a great many unnecessary questions and individual calls for help, and increase the use of the library. 3. It would give the student desirable knowledge, facilitate his work in other studies and better equip him for continued study after leaving the high school and for the activities of life.

BIBLIOGRAPHY IN THE HIGH SCHOOL COURSE.

BY H. M. UTLEY, LIBRARIAN OF THE DETROIT PUBLIC LIBRARY.

The point which I wish to impress most strongly relates not so much to the methods or details of bibliographic instruction as to the importance of it. A little observation in a public library will convince any one that the masses of the people are sadly in need of instruction of this kind. There is not merely ignorance of the sources of information. It is to be expected, probably, that persons who have not close familiarity with books in all branches of literature should know definitely what publications there are which will give them exactly what they seek. These publications are so great in extent and so greatly multiplied in modern times that even educated persons long out of school or college could not reasonably be expected to have knowledge of them. The thing to be lamented is that when books which answer the questions he asks are put into the hands of the average citizen he has not the remotest idea how to go to work to find the answer. This is not surprising. He could not be expected to know by intuition, and he has never been taught.

A reference book is a tool and one must learn how a tool is to be used. We are multiplying schools which teach handicraft, and advocate manual training in schools of even low grades. Familiarity with common tools of the trades is thought to be a desirable feature of one's educational equipment. Is it not equally desirable to give the youth before he goes out into the world some acquaintance with that other tool which will enable him to turn up an important fact in science, literature or art, for which he may have use? I think so.

I have seen men of fair intelligence stumble over the finding of a word in a dictionary. The Detroit library catalogue, made upon the simplest possible plan—that of the dictionary—is worse than a Chinese puzzle to some people. A few days ago a man said to me: "What kind of a library have you anyway? I have spent an hour over your catalogue trying to find something on steam boilers. The most modern thing I have been able to find is this old affair"—and he held up a book whose title page bore the date, 1839. I took the catalogue and showed him under the heading, "Steam engines and boilers," not less than four printed quarto pages of titles of books, most of them modern and some as recent as 1897. He had simply been wasting his time groping in ignorance of the way to go about finding that for which he

was looking. I have no doubt but that many persons come to the library for information who are too timid to ask for help, or ashamed to expose ignorance, and go away with their wants unsupplied, probably condemning the whole institution as a delusion and a snare. A prominent citizen has publicly stated that persons have come to him and complained that the library catalogue is worse than useless, because people can never find anything in it. He was in some doubt whether it ought not to be made over and made so simple that anybody could find everything. On the same theory, the alphabet is so complicated an affair that it should be reconstructed to meet the mental capacity of the illiterate. No alphabet could serve the person who does not know one letter from another. No dictionary can be useful to the person who does not know the order of the letters of the alphabet. No one can get anything out of a book without some little knowledge of the method of its arrangement, its plan and scheme. If he picks this up for the first time and without any investigation, without aid or explanation, seeks to gain from it an answer to some question, he is quite likely to be disappointed. The fault is not in the book. The answer he seeks is there and plain to be seen if he looks for it intelligently. The trouble is in lack of knowledge of the inquirer.

To many people an index is a profound puzzle. The making of an index upon scientific principles is an art which requires much study and mental alertness. The purpose of the index is to tell you where you will find that for which you are looking. For what are you looking? Has the maker of the index anticipated the form in which the question arranges itself in your mind? Perhaps not. You must think of other possible forms of arranging this question, of making one word or another most prominent and so putting it first, of using one or more synonyms for the first or most prominent word. That is your task in searching an index. The task of its maker is to anticipate these various phases of the question and so multiply his entries that your question will be answered at once, no matter under what word you may look for it.

This is merely an intimation of one of the many problems which a study of bibliography involves. Dictionaries and encyclopedias usually index themselves, but he who turns the leaves of either must first inform himself of its plan of arrangement and ascertain whether the scientific or the common form of the name of a subject is used, whether or not he shall look for birds under ornithology. Some general information is essential, and a little ingenuity is useful at times. A gentleman who had invested a considerable sum of money in an encyclopedia which is considered first-class, was greatly disturbed at the discovery of what he thought a glaring defect. He had occasion to look up the subject of india rubber and found that it was not even mentioned. When I showed him that the substance was fully discussed under caoutchouc he was much chagrined to think he had overlooked it.

In this connection there is another matter which directly concerns the modern schoolmaster. A lad of 15 years visited a certain library not long since in search of information about a given city for a school essay. An encyclopedia containing the information was put into his hands and he spent some time turning the leaves, apparently quite nonplussed. A littl inquiry brought out the fact that he could spell the name of the city but did not know the order of the letters of the alphabet. He had learned to read without memorizing the letters. When I went to school the first thing to be learned was the alphabet, and the letters were repeated by rote until they were firmly fixed in the mind. The thing which everybody could do was said to be "as easy as A B C." The modern method is to teach children to read words, and the letters are of no account, except in combination to form words. Should

there not be also an effort to fix in the mind of the child the order of the letters? There are so many ways in which this order comes into practical use that it appears to me of high importance. This ready familiarity with the letters is essentially the first step in a knowledge of bibliography.

So many reference books are now available in our public libraries and elsewhere that some knowledge of the manner of their use is absolutely necessary to all who would keep themselves well informed. So far as the passing generation is concerned this knowledge can be acquired, at best, only in haphazard fashion. But the rising generation ought to get this practical knowledge as part of their school curriculum. The matter is a very simple one and does not involve any overhauling of the course of study. It is not necessary to drop anything now considered essential, nor to add any text-books or hours of study. It may be made purely incidental, with a little oral instruction from the principal, some competent teacher, or the school librarian, a few quizzes, with an opportunity for practical application of the principles taught. Every school library will, or should, furnish the books to illustrate the topic. Bright scholars will very quickly seize upon the ideas, and I feel sure that the subject will prove to be both novel and interesting. When it is seen of how much available usefulness the instruction is to be and how easily it is fixed in the mind by actual application, it is certain to commend itself to every pupil.

I should not consider it necessary to arrange any very elaborate scheme of bibliographic instruction. True, a course might be laid out which would prove to many a very interesting study. But if carried so far as to supplant some other topic this would involve a re-arrangement of the course. Whether this would be wise I will not undertake to say. There is an impression in some quarters that the course is already overcrowded and that too many things are now taught, that it is better to concentrate than to scatter still more. This is a question upon which I am not competent to give an opinion.

My plea for bibliographic instruction merely contemplates that it shall be of an elemental character. There are a few simple principles to be learned, and some practical ideas to be impressed upon the mind by the actual doing of certain things which all will quickly see are very useful. I should think that an hour a week through a term of five weeks would give pupils a very fair insight into the subject, probably sufficient for all practical purposes.

DISCUSSION.

MISS FLORENCE M. HOPKINS, Librarian Detroit Central High School:—An effort, in a small way, at giving talks on bibliography to High School students has been made this year in the Detroit Central High School. Students have been called together, during study periods, for two separate talks. That all students may be reached without interrupting class work, it has been necessary to repeat each talk five or six times; sections varying in number from thirty to one hundred or over.

The first talk was upon indexes, beginning with an ordinary index, and leading through indexes to sets of books, encyclopedia indexes, indexes to atlases, Poole's Index, the Cumulative Index, etc.

The second talk was upon the nature of a few general reference books, such as classical dictionaries, biographical dictionaries, gazetteers, the Century Dictionary of Names, concordances, etc., and an explanation of a card catalogue.

This is the first term that any systematic work in this line has been attempted. The attempt has proved that such work is needed, that it more than pays for the effort, and that it will reward closer attention and systematizing. All talks have been given by the librarian.

SHOULD THE COLLEGE COURSE BE SHORTENED TO THREE YEARS?

Papers were read upon this subject by Professors George Hempl and F. W. Kelsey of the University of Michigan, and by ex-Regent Barbour.

Professor Hempl showed that the concessions that have been made by many of the larger institutions of learning to those students that desire to take up professional or graduate work amount to a reduction of the undergraduate course from four to three years so far as these students are concerned, and that the gradual extension of this privilege to all students may be looked for at no distant date.

The paper by Professor Kelsey, the reading of which required more than an hour, was divided into three parts. First, a brief account was given of the history of the question proposed for discussion and of the results of the practical working of the three-year course, particularly at the Johns Hopkins University. Then the arguments of President Eliot, of Harvard University, of Professor John Henry Wright and others, in favor of the three year course, were subjected to criticism in the light of educational statistics bearing upon the increase in the enrollment of collegiate students and in the number of students in schools of theology, law and medicine who had completed a collegiate course before entering upon their professional studies. The third part of the paper aimed, through an analysis of educational conditions, to reach the causes that have led to the agitation in favor of a three-year course. The limitations of space make it possible to present here only the main results of the paper, which were summarized under seven heads:

1. The educational results of the three-year course, where it has been tried, are not such as to furnish a presumption in favor of its general adoption.

2. Arguments in favor of the three-year course based upon the decline of collegiate attendance, the decline in the relative number of collegiate degree students in the professional schools, and upon the alleged transformation of the colleges into resorts for the "wealthy and leisure class," are contradicted by the facts.

3. The argument in favor of the reduction in the length of the collegiate course in order to lower the age at which professional men may complete their preparation and enter upon active life, has been pressed too far, yet contains an element of truth worthy of consideration, particularly with a view to shortening the period of elementary education.

4. The agitation in favor of a three-year course has grown out of the imperfect adjustment of isolated colleges to partially or completely isolated professional schools.

5. In the case of the University of Michigan, and of other universities with a similar concentration of work on one campus, the relation between the work of the literary and that of the professional departments is by no means difficult of adjustment.

6. The proper solution of the problem of adjustment for such institutions lies in the maintenance of the literary course in its integrity, with the blending of the work of the last year in some cases with the work of the professional departments, thus reserving, to the student, the largest freedom of choice.

7. The solution proposed is not in the nature of a temporizing expedient, but lies in the line of our educational development. In the struggle between competing university types, economy of administration will ultimately insure the dominance of the universities the work of which is concentrated and hence without needless duplication of facilities.

SHOULD THE COLLEGE COURSE BE SHORTENED TO THREE YEARS?

BY EX-REGENT LEVI L. BARBOUR.

I do not propose to discuss the topic from a technical or professional standpoint, but simply as a layman, I remember, however, the substance of what a great professional educator, Professor Fiske, says, viz., that the great progress of mankind has resulted from the increase in the length of the period of adolescence, and I shall adopt that as my text. And the converse proposition is as true: anything which tends to shorten or limit that period, other things being equal, is a retrogressive step. Then, I fancy the average period of study may be taken as the measure of a nation's civilization; and civilization is the measure of the value of life. Yet let us not forget that it is not the things learned that form the greatest value of school or college life, but it is the culture that is implanted, the tastes that are infused, the character of the individual that is formed, and the quality of life that is aspired to. And all this takes time, as it does for a tree to grow. If the growth be too rapid the wood is unsound, the fruit withers before it is ripe, and the tree dies before its time, consumed by dry rot or uprooted by the blasts of winter. Throughout all nature time is necessary for development, and generally the more time the better the development.

The foundation of intellectual life must be of the most sturdy; and the foundation of all true life, after the question of health is settled, and perhaps even before, is education, in its broad sense. Mere animal life, to be sure, has its rights, its purpose, and its duty, yet these all are of infinitesimal account in comparison with the powers and duties of intellectual life.

Our public schools, in their present condition, do not provide, nor prepare for, any such rapid advance in culture and training as warrants the cutting down of the college course. Nor does the popular estimate of what such schools should be. Really, much time in the college course that should be otherwise utilized is required to make up the deficiencies which exist in grammar and secondary school training. I think this is especially true in regard to language study;—English, as well as other languages, both ancient and modern. From investigation of numerous authorities, and from observation, I feel positive in saying that the children of English, French and German schools are far ahead of those in our own schools in all language studies. They are better grounded in them and can make a much more extended and correct use of all languages which they undertake.

We throw away two of the best years for learning—from the age of three to the age of six. Worse than that, when the child is turned loose to play upon the street, this supple twig is bent in directions antagonistic to upright growth and no training can entirely correct the inclinations and habits formed.

If the kindergarten and manual training were universal, if the child's entire play were utilized, and the process of education made the business of the life at home, there might be found in these compensation for the loss of one or even two years of the present college curriculum. But far better, even then, than to elide a year would it be to add two years, and thus raise the quality and stature of the college man.

If the college man intends to be a professional man he cannot for his own personal benefit, nor for the reputation of his chosen profession, know too much of things in general; he cannot have too much culture, nor be too well trained and disciplined in the gentle arts of careful observation and the deduction of correct conclusions. There is no profession or business in life in which success does not depend upon the thorough cultivation of these two powers or faculties of the mind. For, though some men, as Cicero says, may, by their natural ability, excel all that others, with learning, may be able to do; yet what would those men not be able to accomplish had they the ability and training also?

While I compromised with my conscience and judgment, somewhat, in submitting to vote for a combined course of six years with an academic and a professional degree to be conferred when the work was completed, I fear I could not bring myself to think, by any course of reasoning, that it would be well to encourage the shortening process for a collegiate course alone.

If a person cannot devote four years to that process of preparation for life which is designated by a degree, and can only devote two or three years to college life let him be given a certificate stating the studies pursued and the proficiency attained. But do not debase the coin! Let a degree stand for something stable!

Degeneration of ideals and the forsaking of principles seem to be in the air of recent years. If college men do not stand by their ideals and principles, where and to whom may we look for "the saving remnant"?

In the good old days when I was a student, one of the essentials of college training was the building up of ideals and taking a firm stand upon principles. I think that was the main reason, or one of them, of Doctor Tappan's secure hold and lasting influence upon the young men who sat to his teaching. I fear that the professor of his day who proposed to weaken or shorten the curriculum leading up to a degree would have been rebuked.

An indication of this degeneracy of ideals is the hurry that has taken possession of the modern American. With the hurry comes the slighting of the work, and with this slighting comes naturally the conclusion that educative work is unnecessary:—and it is, and worthless, when slighted. This slighting, too, breeds dishonesty, and the abandonment of all principle. This demoralization, I think, is the reason why so many half educated men fail in life; they think that slighted work will go as well as perfect work; their course of education has taught them to believe so; and because such work does not go they think their occupation gone, and turn to something new. Unless the new happens to be a lucky strike, leading to wealth, they are discouraged and die the living death.

There was a time when a rigid curriculum prescribed studies and a training within very narrow limits; and enough of that sort of thing, whether classical or scientific, might perhaps be had for all the practical purposes of common life in a shorter period of time than some people felt inclined to devote to it. But now two things have happened which should certainly prevent the lowering of the standard, or the requirement of less time for study; first, the wide range

given for elective studies has so broadened the field that one may select, and satisfy any taste or inclination; and, second, such hights and depths have been attained in every science and art that a longer, rather than a shorter, period of time should be required for their pursuit.

It seems to me absurd to say that the more there is to learn the less time we should devote to the learning of it, and that the more we realize the importance of character-formation the less time we should dedicate to it

We believe, I hope, in future progress. It can only be made by learning more, and becoming better men. These two are the true objects of collegiate education. It is too low an appraisal of education to esteem it merely as a means of getting on in the world socially, financially or politically, though, of course, it is not harmful to recognize that it is a great aid to any one of these purposes. But, leaving them out of sight, education ought to be considered and prized in and for itself. Its chief merit and use is that it makes the sort of man it does; and if that be so, shall we haggle about a drop of eternity, more or less, devoted to the purpose?

I have heard the baker and the candlestickmaker talk of wasting time in getting an education, of getting one's attention so distracted from business by college studies that one was good for nothing; but I should really dislike to hear a college professor, for the sake of argument or even in jest, pretend that twenty-five per cent of the time and effort actually devoted to college training might, with profit, be eliminated.

Why! those are the happiest days of life, because the most free and the most enlarging. We all know that the growing time of life is the richest and the most enjoyable. It is the perception of progress and not the attainment of any personal and selfish end that satisfies. This is more keenly and truly felt of intellectual progress, and the attainment of no mere material purpose, like financial or political success, can be weighed with it for a moment.

As college training and education establish the ideal of life, they also establish those habits which make the realization of the ideal possible. I think the most important of these habits are those of enquiry and industry. The true student is not indifferent, nor is he wasteful of time. There is always something he wants to know and something he wants to do. These two wants are with him an eternal hunger. And how best shall he be able to satisfy such hunger, except with that provender which the habits themselves provide? The true tree of knowledge bears no bitter fruit, though it bears an infinite variety. And it is this variety, ever increasing to the gaze, that is the attraction of eternity, and produces the longing for immortality. The Heaven of "dancing before the ark" and of "singing psalms before a great white throne" fades away into insignificance, and becomes unattractive, when compared with the realm where infinite love and wisdom are ever revealing new beauties and ever making manifest new truths and new virtues.

When we dream these dreams shall we be willing to lessen by a single day the seed-time which enables us to plant for such a harvest?

THE PERIOD OF ADOLESCENCE.

BY PROFESSOR C. O. HOYT, OF THE MICHIGAN STATE NORMAL COLLEGE.

As usually understood, the period of adolescence extends from the age of fourteen to the age of twenty-five years, but, owing to individual differences in organism due to differences of sex and environment, it is impossible to establish any fixed age. Distinction is generally made between puberty and adolescence, the former being regarded as "the initial development of the reproductive function," while the latter includes the period of about twelve years from "the first evolution up to the full perfection of the reproductive energy." This view is quite generally adopted by investigators, and all lines of research have accordingly been carried on with this in mind. It is thought that the advent of adolescence which comes at the period of puberty is more important than the later stages of adolescence, for "it must be remembered that the character of the earlier period will in a great measure determine that of the later."

The principal method of study has been by means of syllabi. The data obtained in this way are in the main reliable, because the adolescent is at an age and in a mental condition when the written reports regarding himself reflect his true nature much more faithfully than they would if made at a later time in life when he must depend upon memory. The emotional side of life can be studied in no better way. The study of biography has also afforded a fairly fruitful source, serving for the collection of characteristic facts regarding this period of life. A collection of the early sayings and actions of noted personages, shows all of the common traits of the average young person. From these sources much has been collected and a basis has been provided for some conclusions. It may not be out of place, at this time, to make a brief reference to what has already been done for the double purpose of enabling the reader to investigate further for himself, and to show the limited attention that has been devoted to the subject in this country.

1. President G. Stanley Hall in an article in the Pedagogical Seminary, Vol. 1, on "The Moral and Religious Training of Children and Adolescents," has suggested many profitable lines of study.

2. Dr. Wm. H. Burnham, in the same magazine, in an admirable manner has followed out some of these suggestions, which are recorded in his "The Study of Adolescence."

3. "The Psychology and Pedagogy of Adolescence," by Mr. E. G. Lancaster in a recent number of the Pedagogical Seminary, Vol. 5, has given by far the most exhaustive and complete treatment that has come to us. He give the results of his study of hundreds of returns, and his article will prove exceedingly suggestive and helpful to the secondary teacher.

4. In addition to the above may be mentioned "The New Life, a Study of Regeneration," in the American Journal of Psychology, Vol. 6, by Arthur H. Davids, and "A Study of Conversions" by Mr. Starbuck, in the same magazine, Vol. 8, as being valuable. Other articles of less importance have from time to time appeared, but careful reading of all taken together impresses even the casual observer with the prime necessity for a more careful study, a more extended investigation and a more intelligent observance of all of the life principles that pertain to this period. At the same time one is impressed by the false conception which the average person has of

this period of life. It is usual to regard boys and girls at this age as strikingly peculiar or disagreeable perhaps, hard to manage in home and in school, physically awkward and ungainly. The parent breathes a sigh of relief when the child emerges out of this condition, and the teacher seldom sheds tears when this disagreeable boy is advanced to the next grade or leaves the school for all time.

This very imperfectly states an important problem, important not only to the life of the boy or girl, but in a way affecting our social life. The social second birth of the child is now and has been in all ages recognized as of the greatest moment. Among all peoples it has been so regarded, being observed by celebrations, by feasts or by peculiar mystic rites and ceremonies, in which the individual is the most active participant, and is subjected to a trial calculated to test his fitness for life. This thought has come to us through all races and all times and in our later civilization, "the passing of the golden gates of childhood" is made the occasion for feasts or ceremonies, and in the Christian church for confirmation.

Research has shown that in the early years of childhood an exceedingly large number of changes of a physiological character take place. They are not, however, strikingly important. While one might be impressed with the more obvious changes marking the advent of pubescence, and from this point of view regard them as more important than the earlier changes, because more noticeable, yet it is believed that functionally they do not, with possibly one exception, tend to exert influences of extreme vital importance. The various outward physical changes are obvious to all. A consultation of Bowditch's tables shows that in boys the greatest height increase occurs at the ages of 13, 14, and 16, when the average is 2.75 in.; in girls the greatest increase is 3.37 in., which occurs at the age of 12. There are two periods of greatest gain in weight in boys: at the age of 14 and 15 the average gain is 11 pounds per year; while at the age of 16 it is 12.83 pounds. In girls the greatest gain is 11.09 pounds, which takes place at 12. Donaldson has shown a peculiar variation in brain weights, occurring at this period. The brain weight in boys at 13 is 1500 g.; at 14, 1300 g.; and at 15, 1500 g.; in girls at 13, 1250 g.; at 14, 1350 g.; and at 15, 1250 g. It is thus seen that in boys the greatest brain growth occurs at the time of greatest gain in height and weight, while in girls the greatest brain growth takes place two years after the period of greatest gains otherwise. The greatest brain change, however, it is thought, is in the large increase and medullation of association fibers. There is also to be noticed the relative changes between the size of the heart and arterial system. In childhood the former is relatively small; with the advent of pubescence this is changed. The functional changes in the reproductive organs, occurring earlier in girls than in boys, and being different in character, produce striking outward physical changes and actions. Lancaster has shown that the change in the angle of the vertical axis of the pelvis, together with the rapid growth of the hip bones, makes the girl taller than the boy. This affects the standing and walking positions. New movements must be acquired, being attended oftentimes by great difficulty and serious inconvenience. At the time of greatest growth in boys, the growth of bone and muscle is not co-ordinate, the resulting maladaptation producing extreme lassitude and inertness on the one hand, or clumsiness and awkwardness on the other. This makes possible abnormal fatigue with little exertion. At no time is there such a variation of the fatigue curve as seen at the time these changes are taking place.

The changes in psychic power and function as manifesled by unusual and sometimes abnormal activities are of such a character that they demand careful consideration, especially if the teacher hopes to profit by her study of the adolescent, and desires to benefit him by her knowledge of his nature. Psychologically he is often an enigma because of the conflicting and contending storm and stress of ideas as he is swayed to and fro, in his actions, by the overwhelming domination of the ever-changing emotions. In a general way it is obvious that this period when viewed in contrast with others, may in the main be characterized by saying that there is accelerated physical growth always accompanied by an increase of intellectual activities and intensified emotional interests. This has produced great results, as reference to the world's history will show. The world's work has been largely done by the adolescent.

In this great intellectual awakening, characterized by the most intense altruistic feeling accompanied by increased love for nature, music, art and literature, these strong ideals have gone out in action that on the one hand, under the proper direction and sympathetic guidance of the intelligent teacher, has produced the master in science or art, or on the other hand, without this proper direction, the world's great criminals and insane. It is easy for the scientific writer, in the quiet of his study, coldly studying hundreds of statements and confessions made by the unknowing yet knowing adolescent finally to say to us, that the young man is experiencing a a strong emotional period of life, that in the storm and stress of doubt he is fluctuating in his enthusiasms and in his interests, that he may be easily converted to Christianity, and yet that in the general instability of unformed character frequent and dangerous moral aberrations are experienced. But for the parent or teacher, having in view his own particular aim of education and life, and too often regarding the young person from his own adult point of view, to realize this is extremely difficult. When this realization is brought about it is not unreasonable to hope that there will be a greater contribution to future civilization than there has been in the past.

Interesting and valuable as it is to the psychologist to study from a scientific standpoint the various phases of mental phenomena as seen in adolescent life, the "focal point of all psychology," such study is of more value to the teacher, since it is he who must practically apply, and approve or condemn the principles or laws discovered. I shall therefore turn to the pedagogy of the subject and endeavor to base practice upon some pretty thoroughly established theory.

I. *Motor Training.* It is believed to be true that with the young child the necessary complement of the idea-forming process is the motor element; that impression on the one side demands expression on the other to complete the mental process. Motor training is then an important educational factor not for the sake of activity itself, but because it is educative. With the adolescent, however, there is activity of quite another kind, activity that is not the reflex of a single stimulus to a sense organ, but activity due to an increased blood supply and to stronger ideas gained through keener sense organs, modified by previous experiences, and developed into changing ideals. There is need for a means by which this activity may be turned into educational channels. Back of it lies a deep enthusiasm and interest. It has been suggested that Herbart's doctrine of interest might be put into practice with the adolescent as well as with much younger children. This may not be true, but we do know that the adolescent must experience excitement and must do some-

thing—a necessity growing out of the rational demand that the physical and mental life be kept pure, healthy and growing—otherwise immoral gratifica-of desire is likely to result. Therefore all interests of whatever character they may be, should be ascertained and then the motor complement, whether it be athletic, scientific, artistic or literary, should be supplied as a part of education. It may be by way of a celebration of a football victory, or it may be of a more intensely utilita.ian character in the manual training shop. As a part of the educative process it matters not which. The boy's nature demands activity, and we must supply the demand.

II. *Environment.* A number of peculiar conditions surround every adolescent, which, in their vital relations to the child are imperfectly understood, and it is to be feared, are indifferently regarded by both parent and teacher; in fact, by all with whom the young adolescent comes in contact. If this is not so there is a neglect somewhere that is almost criminal. These conditions may be summed up as all the influences with which the young adolescent is brought in daily contact, outside of the school. Upon these depend his physical and spiritual being, as to kind and modification. The amount and kind of food with which the body, when the demands are greatest, is nourished, should be quite as carefully attended to at this time as at any other period in life. Sleep is another important consideration. Too often, it seems, natural growth is retarded by an insufficient amount, and in its effects manifests itself not in the physical nature alone but in moral action. The proper attention to dress and care of the person stand as elements in the environmental conditions, equal, if not superior, in importance to all others. This is referred to because of its bearing upon the delicate and shunned question of sex-hygiene, to which only the barest reference may be permissable. One has only to read the statements of girls in numerous confessions made to different investigators to realize that some one needs education. One has only to glance at any newspaper and there read the advertisements appealing to young men. If you could penetrate the sanctum of this "medical company" and could gain access to the letter files, and could read a few of the thousand letters written by deluded boys, and then if you could know in your own school what your boys are doing, I think all would agree with me that someone needs educating, and that kind of an education, too, that means a legislation sufficient to put a stop to the nefarious practices by which pure youth and bright young manhood are ruined. I wish to offend no one by this allusion, but it seems to me of such vital importance and of such vital interest to all young people as to demand your attention. Let the teacher through co-operation with parents unite the two great forces of education, the school and the home, that the influences of environment of whatever character shall be pure and natural and produce the strongest lives.

The practice recently introduced in many localities of providing for physical examinations and medical inspection at stated times during the year is one that should be extended. By this means, it is believed, many evils would be remedied, right ends conserved, and causes of hitherto strange and misunderstood actions might be pointed out and remedies provided. We are too often called upon to meet the charge of "overpressure in the schools." They tell us that our requirements are so rigid and the work so severe that the physical and mental strain undermines health, and in consequence pupils are compelled to relinquish school work. While conservative school men are willing to admit as true some of these grave charges, as shown by their willingness to change their courses of study, by adapting them to the growing

needs of the student, as he is better understood and these needs better appreciated, grading him according to his ability to do mental work without fatigue; yet it is probable that if there were a better understanding of the true condition that would be afforded by the physical examination referred to, not a few of the results now charged to overpressure and hard study, could then be traced to heredity, or poor environment, perhaps to insufficient or inadequate food, improper dress, irregular habits, immoral practices, etc.,—conditions for which the home or other extraneous influences are as responsible as the school. Better co-operation of home and school would do much to apply a remedy, if causes were agreed up.

III. *School Management.* In a way, the most practical application, pedagogically, of this question, is to be found in its relations to all phases of the school economy, and may be included under the general term, management. It might be noticed, however, in passing, that much more research is necessary along hitherto uninvestigated lines before anyone will be able to speak with authority. More light is needed upon the question of the mechanical requirements involved in buildings, courses of study, methods of administration, etc. It is to be hoped that contributions may be added to those already secured.

There is one point that seems of importance, to which it may be profitable to direct our attention. It is generally conceded by all, the concession being more or less vaguely based upon uncertain statistics, that relatively but a small percentage of pupils continue in school much beyond the advent of the pubescent age. The falling off seems to be greater in the case of boys than with girls. I am not aware that any one has investigated this question extensively enough to give us accurate figures as to the number of these pupils, their age, or the grade in which this falling off takes place. The answer that usually meets the inquiry: "Why did so-and so leave school?" is "He or she," as the case may be, "has left to go to work." While it may be true that the boy or girl is at work, for few parents will permit idleness if they can avoid it, a doubt arises. Did he leave school actually to go to work? Was he obliged to go to work? Was he obliged to do this in order to contribute to the maintenance of the family? Is it not true that back of it all there is another reason, to be found in the boy himself, in the home or in the school, that will account for it all, and were it known, might have been adjusted? Teachers may well be led to question, How far am I responsible if this boy leaves my school at the seventh or eighth or ninth or any other grade? Did I, because I did not understand him, drive him away? Let us look at the adolescent himself for a moment. With the advent of this new birth, there is a self-revelation of the existence of new powers, impulses to actions not easy or possible of control, and tendencies to strange thoughts and peculiar actions not in harmony with past experiences. This gives rise to dominating activities which manifest themselves in a desire to be a leader, to form new associations and to break old ties. Any attempt to hold the subject under the old regime of his life is met with a rebellious attitude. At this stage of his life should the conflict of authority be co-ordinate with any manifestation of the migratory impulse, all these ripe and new impulses are liable to pass over into some kind of action with no definiteness of purpose. This action may or may not be determined by the ideal that in some mysterious way has come as a physical attendant to the physiological changes, and in no way conditioned or controlled by ideals given to him at an earlier period of life. I believe many boys and girls leave school in this way and

under these conditions, and I believe, furthermore, that the remedy is to be found either in the school or in the home, or in both.

From the standpoint of the educator we should be willing to concede that one remedy lies in better teaching in the secondary school. Nothing more need be demanded in an academic way; what is asked for is a better understanding of the pupils, and this will require a different method of treatment from that which he has needed in the past or will need by and by. Quite too often the application of the principles of interest found so important and necessary in the teaching of children in the lower grades is felt by the secondary teachor to be unnecessary, and is even looked upon as childish when the teacher has to deal with young men and women. When, however, a teacher is found who does recognize this principle and uses it in kind but not degree, a marked increase of success and influence is seen. The young adolescent has a living interest in nature, music, literature and art. In the utilization of these materials in determining the selection of subject matter of his instruction, we only recognize for the time being his necessities. This is imperative. Else we shall find ourselves forcing him contrary to the line of least resistance in his nature. The teacher at her best needs to be a leader in shaping the kind of ideal and in her leadership through the employment of perhaps the greatest pedagogical principle, suggestion, should cause the pupil to feel that he himself is the leader. This will take him into the great range of activity, the mainspring of which is enthusiasm.

We often think the boys or girls of fifteen or sixteen are men or women. But it should not be forgotten that in their many changing moods they do not know or understand themselves. They misinterpret our actions; they charge us with injustice; at times they seem to be against every one and feel that every one is against them. Then, at the opportune moment, mother or teacher, with suggestion and sympathy, given in the right way and in the right spirit, wins the victory. Many a student has been kept in school thus, and I believe many a one has "left school to go to work" on account of the lack of this kind of treatment.

These suggestions are not given in a spirit of criticism. They are an outgrowth of a series of studies and are given in the hope that they may call attention to this very important life epoch, with its peculiar characteristics.

IV. *Religion.* It has been shown that in the adolescent period occur by far the greatest number of conversions to christianity. The school must not teach creed; it is expected to provide ethical instruction, and the aim of all good teaching will have these ends in mind. The church admits, as science proves, that this new birth is a reality, and recognizes the demand for a cultivation of religious emotion without the influence of denominational creed. Let the love of nature and art and the good as we find it, suggest the method by which these emotions may be developed. "After the nature stage present the ideal. Hold up noble, religious lives and let the suggestion leaven the whole nature." The life of the child seems to demand that the character of the teaching shall possess this ethical and broad religious element. With this thought in mind as a part of the end, with a stern conviction of right and character presented in the ideal heroic God-man, the adolescent will through his instruction adjust himself to his environment and come into his rich intellectual and spiritual inheritance.

Dr. Hall has said, "I think we may say, anthropologically, that puberty is the period when education as a conscious, special or public function began, and has slowly developed as civilization has advanced, downward to

the kindergarten and . . . upward toward an ever increasing maturity of post-graduate work."

This vital life period has been but very imperfectly understood. It involves many interesting problems, the careful and candid investigation of which, for the sake of the young, demands the earnest consideration of all of us. To this end I present these suggestions to you, trusting that they may be provocative of thought along settled lines and of investigation into yet unexplored fields.

DISCUSSION.

SUPERINTENDENT S. B. LAIRD, Lansing:—Being one of the humblest workers in the state I feel somewhat embarassed in this scholarly company in attempting to discuss a theme, tabooed by some and presented in such a way by others as to offend sensible people. This condition demands not that we should leave it alone, but that it should be dealt with according to its importance in a wise and tactful fashion.

Dr. Christopher tells us that there are three crises in child life:—first, the dentition period from six or seven months to perhaps three and a half years; second, the period of "easy fatigue," from seven to nine years; third, the adolescent period, from fourteen to twenty-five years with boys and from twelve to twenty-one years with girls. For the first the school has no responsibility. The second concerns the upper primary grades, and its conditions and needs should be thoroughly understood by those who minister to childhood during those years. The third begins about the sixth or seventh grade and with the majority of pupils continues throughout the remainder of school life. Within the limits of this last period and extending from the twelfth to the sixteenth year usually, is the most critical period of child life known as puberty. It is during these years of "storm and stress" that the transition from childhood to manhood aud womanhood occurs: and the surroundings, care, direction and atmosphere of these years determine largely the strength, ambition and success, or failure, of the individual in his life efforts.

The changes which mark the adolescent state are both physical and psychological and should be understood by parents and teachers. The rapid growth, the taking on of ancestral traits and features, the demand for more liberty, the changes in the nervous system, the growth of the heart and of the reproductive organs, all demand a wider range of knowledge of these conditions and of how they can be best treated. It is the age of feeling, of new sensations and of social and ethical impulses.

This period is fraught with many dangers. The sexual elements of soul and body should not be developed prematurely or disproportionately. Compensating and controlling powers are unfolded which, if not too late, serve as a steadying and guiding force during this crisis. There is danger that the thoughts, feelings and imaginations of the adolescent while centering upon self so largely may induce a condition of morbidness and abnormal self-consciousness which will repress rather than encourage a true development.

There is danger that a rigid economy of every life force may not be conserved and that a holy respect for one's body may not be realized. The motor activities should be utilized, but care should be taken that undue fatigue should not result. Excitement along any line should be guarded against, since the judgment is not yet able to cope successfully with the feelings. Some one has said that the pedagogy of this stage of development is expressed by the words, "Inspire enthusiastic activity."

At this stage of child-life, perhaps more than any other, should the question be asked, What is essential to success in life? The answer must be given in terms of physical health and vigor, as well as in those of the moral qualities known as courage, fortitude, energy, justice, etc. The symmetrical development of body, mind and heart finds its reason for realization now, if ever. There are certain, definite, positive needs that the school should supply at this period. First, the teachers should have intelligent conceptions of the adolescent stage, both as to its

dangers and possibilities. Until regular medical inspection of public schools is secured, the teacher can render most efficient service in this direction. I do not say that he should be held responsible for this knowledge, but I affirm that here is a golden opportunity to serve the race, and blessed is he who sees it and prepares for it. This knowledge, however, will not suffice. It must be accompanied by intelligent sympathy and deep-seated interest in the highest welfare of the pupils. A burning desire to be helpful will constrain one to become familiar with the means for so doing.

Second, the school must seek to plan its work for both sexes so that the cases of arrested physical development may be as few as possible. I regard this phase of the subject as of vital importance. The question is not whether in high school and college the young lady is able to maintain equal intellectual rank with her brother. She has proved her ability to do so. Nor is it whether she is brave and ambitious enough to attend school twenty days out of each school month. That also has had an affirmative answer for years. The great question is, From the view-point of her future energy and power, and from that of her relation to race development, can she afford to do the work of the schools in a boy's way? The freedom given young ladies in some eastern colleges, viz: that of being absent from classes one-fourth of the time with special excuse, and a similar custom in our own University, are steps in the right direction. But the high school has a duty also in this line and it is coming to be imperative Greater flexibility of courses, more elective work, and larger freedom in the accomplishment of mental tasks, demand the earnest attention of school boards and superintendents. Besides these features, a gymnasium under wise medical direction should be an adjunct of our high schools. By their means our girls could be sent to college with strong, well developed bodies, as well as trained intellects, and the family, the state, and the race would be the gainers thereby.

Third, our school and city libraries should be so classified and furnished with proper books for this period of life, that the teacher and librarian could be of service to the adolescent boy and girl. The books needed should have the following qualifications: 1. They should be interesting. 2. They should contain healthy, wholesome and natural views of life. 3. They should present high ideals. 4. They should be good literature.

Fourth, the schools should be able to recognize cases of malnutrition and some of the resulting diseases, such as rickets, epilepsy, catalepsy, hysteria, St. Vitus's dance and paralysis, and counsel with parents concerning them.

Fifth, the school should do its best so to train youth that they will abstain from the use of tobacco and stimulants during this critical period, and, thus preserving their physical, mental and moral health, have some capital upon which to predicate success. A cheerful, healthy atmosphere in the home and school, good companions, good books and wise training will perpetuate that race to which the world looks for example in all qualities which point to future leadership.

In the presence of these great responsibilities, upon which such far-reaching results depend, the educational guides of our youth may well adopt the motto of Horace Mann when he gave himself to the work of education in Massachusetts: "God grant the annihilation of selfishness, a mind of wisdom and a heart of benevolence."

[NOTE — The next issue, containing the proceedings of the conferences, will appear May 28.—EDITOR.]

33 never published.

PROCEEDINGS

OF THE MICHIGAN SCHOOLMASTERS' CLUB AT THE THIRTY-FOURTH MEETING HELD IN ANN ARBOR MARCH 30 AND 31, 1900.

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MICHIGAN SCHOOLMASTERS' CLUB.

PROCEEDINGS OF THE THIRTY-FOURTH MEETING, HELD AT ANN ARBOR, MARCH 30 31, 1900.

PAPERS.

THE LEGAL STATUS OF THE TEACHER.

FLOYD R. MECHEM.

The subject upon which I have been asked to speak, is the legal status of the teacher. In endeavoring to comply with this request, I have assumed that such an audience as this would not be interested in the bare legal aspect of the question, as an audience of lawyers might be. Nevertheless, any effort to speak upon the teacher's legal status necessarily presupposes that what is to be said on the social, political, or pedagogical sides of the matter will be said by others, and that only that which pertains to the legal aspect is now in order. The mass of material from which the lawyer might select that which would be appropriate to his needs is now great, and presents many questions of a wholly technical nature, as well as much matter merely of a temporary or local interest. Attempting to eliminate this as of no interest to you, I shall confine myself to the larger and more general aspects of the subject.

It is, of course, at this day, simply a truism to say that the subject of education is one of the most important with which a free state has to deal. Although it may formerly have been true that to a large degree the matter of education was left to individual initiative and enterprise, and although education, in many places and to some extent, is still in private hands, it is now generally agreed that the proper education of its people is one of the most vital concerns of the State itself. In these states which were carved out of that great domain known as the Northwest Territory, the duty of the State was early recognized, and the sentiment was embalmed in those striking sentences so familiar to us all: "Religion, morality, and knowledge, being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged." In the territory, therefore, with which we are acquainted, particularly, while private schools and private

teaching are by no means unfamiliar, the great bulk of the teaching energy is under the control and direction of the State.

This fact suggests that there may be important distinctions in the legal aspect of public and of private schools and teachers; and without meaning to intimate that the private schools and teachers are beyond the reach of State regulation and supervision, it is clear that public schools and teachers are subject to such regulation, and it is with the public school teacher that we are now more immediately concerned.

That the maintenance and support of public schools is one of the public purposes to which public funds may be devoted, and for which the power of taxation of the State may properly be invoked, seems everywhere to be conceded. As stated by an eminent authority: "It may be safely declared that to bring a sound education within reach of all the inhabitants has been a prime object of American government from the very first. It was declared by colonial legislation, and has been reiterated in constitutional provisions to the present day. It has been regarded as an imperative duty of the government; and when question has been made concerning it, the question has related not to the existence of the duty, but to its extent."

The public school is herefore clearly a public institution, and the public school teacher is in some degree a public functionary. He is even to some extent, it has been said, to be regarded as a public officer.

Because the public school teacher thus occupies a public and important position, it is clearly within the competence of the State to prescribe what shall be his qualifications and what the method of determining their existence. In the case of the common schools, elaborate provisions are often made for the examination and certification of teachers by public officials chosen for that purpose. In the case of the higher schools, the matter is not infrequently left to the determination of the boards or bodies having those schools in charge, though the tendency here seems also to be in the direction of formal examination or certification by some public authority.

The laws providing for examinations often specify with much minuteness what shall be the subjects upon which the candidate is to be examined, and what percentage of correct replies shall entitle him to a certificate. The opportunity, moreover, is not infrequently improved to make the examination of the teacher and the course of instruction in the school in which he is to teach, the medium for propagating some one's special views upon other subjects than those which are ordinarily regarded as purely pedagogical. The now familiar requirement that instruction of a certain kind and to a prescribed amount shall be given with reference to the supposed effect of tobacco and intoxicating liquors upon the human system, is an example of this tendency.

In [illegible] matter of scholastic attainments, moreover, it is competent [illegible] or authorize reasonable classifications of teachers [illegible] Thus a minimum or maximum age may [illegible] teachers may be required for colored schools, [illegible] in fact constitute the great body of teachers, it has been held [illegible] competent to require that certain teachers, for example, the principals of [illegible] grammar schools or large mixed grammar schools, should be [illegible] Even where the Constitution of the State expressly provided that [illegible] one years of age and upwards should be eligible to any office of [illegible] management under the school laws of the State, it was held that

reasonable discrimination with reference to the sex of teachers might nevertheless be made.

On the other hand, discrimination based upon religious belief would not be justifiable. The public schools are not to be made the place in which, or the medium through which, religious instruction is to be given; but, at the same time, a teacher, otherwise qualified, is not to be discriminated against because he does not hold the religious views of the community, so long as he does his duty and does not use his position as a means of propagating his own religious notions.

In a recent case in Pennsylvania, it appeared that the inhabitants of the school district were largely Catholics. The school board was wholly composed of Catholics, and about ninety per cent. of the voters were Catholics. Eight teachers were employed in the public schools, and of these six were members of a Catholic sisterhood. These Sisters held regular certificates granted by the County Superintendent, but the examination had been a special one, held by him at the house of the Sisterhood. The Sisters while in school were dressed in the peculiar garb of their order, with a crucifix suspended from the neck and a rosary from the girdle. They were addressed by the pupils as "Sister." During the regular school hours the ordinary studies were pursued, but after school the Catholic pupils were detained for drill and recitation in the Catholic Catechism. On Catholic holidays and feast days, the schools were closed.

Certain Protestant parents whose children attended the school applied to the court for an injunction to restrain the employment of these Sisters as teachers, and, if this could not be granted, to forbid the teachers from wearing their distinctive garb in the school room, and from teaching the Catholic Catechism in the school room after school hours.

The court granted the injunction against teaching the catechism, but held, (one judge dissenting,) that it was within the proper discretion of the school board to employ these Sisters as teachers, and that no one's rights were violated by their wearing their peculiar garb in the school room. The court, moreover, suggested that it as entirely competent for the State not only to permit but to require teachers to wear, while on duty, some approriate garb or uniform, like policemen or railroad officials.

Under the Wisconsin constitution, the stated and regular reading of the Bible in the public schools, was held to be "sectarian instruction" and made the school a "place of worship," within the prohibitions of that instrument, even though children whose parent objected to it, were not required to remain in the room during the reading. On the other hand, under the Michigan constitution, the reading of selected extracts from the Bible during the closing hours of each session, from which any pupil might be excused upon the application of his parent or guardian, was held not to constitute religious worship or to make the teacher a "teacher of religion."

What the social status of the teacher is or should be, seems not often to be made the subject of express legal regulation. In the case of Chauncey Depew, an Englishman is said to have concluded that, because Mr. Depew had his office in the Grand Central Station, he must belong to our "great middle class." Whether so well founded a presumption could be made with respect to any other of our teachers than those who are assigned to the "Central" building, may be open to question.

In 1814, an English lawyer objected to a bail bond on the ground that

one of the signers, who was a schoolmaster, had been erroneously described as a "gentleman;" but the court held the bond good, saying that the description was sufficient.

I do not suppose that this would be regarded as a judicial determination that *all* schoolmasters are gentlemen; but it might, perhaps, be regarded as an opinion that it it not legally impossible for some schoolmasters to be gentlemen.

Where the statute, as in this and many other states, prescribes the qualifications which shall be required, it is common to provide that no contract shall be made with any teacher who is not at that time qualified as the law provides, and to declare that any contract made in violation of such a provision shall be void.

These provisions have usually been regarded as mandatory, and the courts have enforced them with strictness. Thus, where the statute requires the possession of a certificate as the evidence of qualification, it is held that the teacher must have obtained the certificate at the time the contract is made, and that its subsequent acquisition, even before the term is to begin, will not cure the defect.

It has moreover, been held, under these statutes, that even though the unqualified teacher may have taught the school for the full term without objection, he can recover no compensation—he cannot recover on the contract—for that was void—nor can he recover for services rendered, in those cases, at least, in which recourse must be had to State funds for his payment.

It is common, further, for the statutes to specify, by what *officers* and in what *form*, the contract with the teacher shall be made and these requirements also are usually deemed to be mandatory. Thus where the statutes required that the teacher should be hired at a *meeting* of the board, it was held that the separate and individual concurrence of the members was not sufficient; and where *all* of the board are required to act, a contract made by part only, without notice to or concurrence by the other members, is not valid.

Whether defects of this sort may be cured by the subsequent recognition of the contract by the board or the school district, has been much questioned in the courts, but the prevailing rule is that if the defect relates to mere matters of form and to the conduct of the district officers, the subsequent recognition of the contract by the body having the power to make such a contract will be deemed to be a ratification of it.

Whether one school board may lawfully make a contract for a period extending into the official term of the successors of that board, has also been discussed under various statutes, with a preponderance of opinion, perhaps, to the effect that it cannot be done.

Authority is usually expressly conferred by statute upon school boards to make rules and regulations for the conduct of the school, but even where no such express authority is given, the power of the school board to make reasonable and appropriate rules could not be doubted.

Such reasonable rules bind teacher and scholar alike. The teacher is bound by them, and must enforce or be governed by them, as the case may be. What regulations would be deemed reasonable under varying conditions can not be determined by any hard and fast rules, for much must always depend upon the circumstances under which they are to be enforced; but as a few, out of many passed upon the courts, the following have been held to be reasonable and valid:

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A rule that pupils in a public high school shall employ a certain period in the study and practice of music and provide themselves with certain books therefor, or for unexcused disobedience be expelled; that pupils who are absent, without satisfactory excuse, six half days in four consecutive weeks shall be suspended; that schools shall be opened with reading from the Bible and prayer, during which each pupil shall lay aside his books and remain quiet, or shall bow his head unless his parents request that he shall be excused from doing so, and for wilful disobedience he may be expelled; that pupils shall write compositions and take part in rhetorical exercises, or be suspended for disobedience; that pupils guilty of persistent misconduct be expelled; that children of immoral and licentious character be excluded; that the doors shall be locked and no scholar admitted for fifteen minutes during the opening exercises in the morning, provided due regard is had to the weather, and the age, health and comfort of the excluded pupils; that white and colored children shall be taught in separate apartments, provided equal accommodations are provided for both.

But, on the other hand, the following regulations have been held unreasonable:

That no pupil shall, during the school term, attend a social party, and for disobedience expelling him; that pupils who carelessly or wantonly injure or destroy the school property shall pay for the same, and for failure to pay, whipping or expelling them; barring the doors in cold weather against little children who are late; refusing admission to a public college because the applicant is a member of a Greek letter fraternity or other secret college society; requiring every scholar on returning from recess to bring in a stick of wood for the fire.

But even though the regulation be in itself reasonable, it must also be enforced in a reasonable manner and under proper circumstances, with due regard to the health, comfort and welfare of pupils and teacher.

Where the school board or other proper authorities have prescribed no rules, it is within the power of the teacher to make rules for the government of his school.

The implied power of the teacher to legislate in this respect is doubtless more restricted than the implied power of the school board under like circumstances; and little more can be said than that the teacher has the implied power to make and enforce such rules and regulations as are reasonably necessary and proper for the good conduct of his school in all matters not provided for by the school authorities and not prohibited.

And even where rules have been prescribed by the board, the teacher may, unless expressly prohibited, make such additional rules and requirements as special cases or sudden emergencies may render necessary.

But as the rules prescribed by the school board must be reasonable ones, *a fortiori* must those be reasonable which are ordained by the teacher. Instances of what rules are or are not reasonable have already been given, and the same principles would apply to those made by teachers. But, in general, "acts done to deface or injure the school-room, to destroy the books of scholars, or the books or apparatus for instruction, or the instruments of punishment of the master; language used to other scholars to stir up disorder and insubordination, or to heap odium and disgrace upon the master; writing and pictures placed so as to suggest evil and corrupt language, images, and thoughts to the youth who must frequent the school;" using profane lan-

guage, quarreling and fighting among each other,—these and many other similar and obvious acts the teacher may prohibit and punish.

So, in regard to the studies to be pursued, the teacher may, where no rules are prescribed by the board, exercise a reasonable discretion "as to the order of teaching them, the pupils who shall be allowed to pursue them, and the mode in which they shall be taught;" but the teacher shall not compel a pupil to pursue a study which he knows the parent has forbidden his child to take.

The authority of the teacher is not confined to the school-room or grounds, but he may prohibit and punish all acts of his pupils which are detrimental to the good order and best interests of the school, whether such acts are committeed in school hours or while the pupil is on his way to or from school, or after he has returned home.

Upon the question of the teacher's control over the pupil out of school hours, and off of the school ground, a New England court forty years ago laid down these rules, which, while savoring somewhat of New England rigor, have never been elsewhere questioned.

It was conceded that the master's right to punish extended to school hours, and the court said there seemed to be no reasonable doubt that the supervision and control of the master over the scholar extended from the time he leaves home to go to school until he returns home from school.

After his return home, the pupil comes again primarily under parental discipline, but even in such a case the court declared that if the act done, though at home, had a direct and immediate bearing upon the welfare of the school or upon the authority of the master and the respect due to him, the master might punish the scholar if he came again to school.

For the purpose of maintaining the order and discipline of his school, the teacher, it has been held, has the inherent power to suspend a pupil from the privileges of the school, unless he has been deprived of that power by the affirmative action of the proper board. If he so suspends a pupil, he should at once report the fact with the reasons to the board.

But while the teacher may thus suspend a pupil, he has no inherent power to finally and entirely expel the pupil. That power belongs properly to the board, unless by statute, or other regulation, some different rule has been enacted.

Upon the vexed and vexatious question of the right of the teacher to inflict corporal punishment, it is not easy to lay down positive rules. It is clear enough to any one that the public sentiment in regard to the subject as it affects home and school discipline, has greatly changed in recent years, and is still in an unsettled condition. This change in public sentiment is certain to make itself felt in legislation and in the decision of the courts. In many places, rules have been enacted forbidding the infliction of such punishment by others than the principal. Up to the present time, however, the courts have uniformly sustained the right of the teacher to inflict reasonable corporal punishment.

In dealing with the question the court in Vermont, in a somewhat early case, laid down rules which have been quite generally approved. Said the court:

"A school-master has the right to inflict reasonable corporal punishment. He must exercise reasonable judgment and discretion in determining when to punish and to what extent. In determining upon what is reasonable pun-

ishment, various considerations must be regarded,—the nature of the offense, the apparent motive and disposition of the offender, the influence of his example and conduct upon others, and the sex, age, size, and strength of the pupil to be punished.

"Among reasonable persons, much difference prevails as to the circumstances which will justify the infliction of punishment, and the extent to which it may properly be administered. On account of the difference of opinion, and the difficulty which exists in determining what is a reasonable punishment and the advantage which the master has by being on the spot to know all the circumstances, the manner, look, tone, gestures, and language of the offender (which are not always easily described), and thus to form a correct opinion as to the necessity and extent of the punishment, considerable allowance should be made to the teacher by way of protecting him in the exercise of his discretion.

"Especially should he have this indulgence when he appears to have acted from good motives, and not from anger or malice. Hence the teacher is not to be held liable on the ground of excess of punishment, unless the punishment is clearly excessive, and would be held so in the general judgment of reasonable men. If the punishment be thus clearly excessive, then the master should be held liable for such excess, though he acted from good motives in inflicting the punishment, and in his own judgment considered it necessary and not excessive. But if there is any reasonable doubt whether the punishment was excessive, the master should have the benefit of the doubt."

In a late case in New Hampshire, it appeared that a school teacher had been annoyed by repeated unnecessary coughing among the pupils; and he requested its cessation. It continued, however, and on one occasion while the teacher was in the midst of an expostulation against it, a pupil coughed. The teacher, interpreting this as an act of defiance at his request, inflicted some moderate personal chastisement upon the pupil. The pupil, claiming that he was affected with whooping cough and that the cough in question was involuntary and beyond his control, sued the teacher for assault and battery. The trial court instructed the jury that even though the pupil's claim was true, the teacher would not be guilty if he, in good faith, believed that it was a voluntary act done for the purpose of defying his authority and disobeying the rules of the school. Upon appeal to the Supreme Court of the State this ruling was affirmed, the court saying: "The law clothes the teacher, as it does the parent in whose place he stands, with power to enforce discipline by the imposition of reasonable corporal punishment. He is not required to be infallible in his judgment. He is the judge to determine when and to what extent correction is necessary; and, like all others clothed with a discretion, he cannot be made personally responsible for error in judgment when he has acted in good faith and without malice."

The teacher also owes some duty, not yet clearly defined and fortunately not often called in question, of protecting the children under his care against injuries resulting from their helplessness and inexperience. To some extent, for a limited time, the teacher stands in *loco parentis*, and while it has never been decided, so far as I am aware, how far the teacher is, or should be held, responsible for either physical or moral injuries to the children which the teacher might have prevented, I feel very sure that we shall all agree that both law and morals should require the exercise of reasonable care and fore-

sight in the protection of the pupil. In an English case, a teacher was held liable for an injury to a pupil from fireworks which the teacher had permitted the child to have and use, and while there were peculiar circumstances attending this case, I have no doubt that the principle is one of more extended application.

The duty of the teacher is primarily to teach, and, except when the contract or well established custom so requires, he could not be expected to be janitor and wood-cutter besides.

In many country districts, however, it is the well established custom that the teacher shall build his own fires and sweep and dust his school-room, and one who undertakes to teach with knowledge of this custom would doubtless be deemed to have assumed these duties also.

The statute in this State requires the school district to provide the school-house with the "necessary appendages," and among these necessary appendages are specified a "looking-glass, comb, towel, water pail, cup, ash pail, poker, stove shovel, broom, dust-pan, duster, wash-basin, and soap," but it fails to specify who is to use these articles, or to what use they shall be put. Inasmuch as only one towel and comb are required, it may be that these articles are valued for their suggestiveness rather than for any actual use which may be made of them.

The teacher who has performed his contract is entitled to his salary or wages as agreed. From this no deduction is to be made by reason of holidays upon which schools are not usually kept open.

And where the teacher has stood ready to perform his part of the contract, the fact that the district may not have been able or willing, without any fault on his part, to avail itself of his services, furnishes no excuse for not paying. Thus where the school is closed by reason of a lack of funds, or because of the prevalence of contagious diseases, the teacher who has been ready and willing to perform may recover for the full period.

In the absence of a statute providing otherwise, it would be entirely competent for the school authorities and the teacher to agree, as to the duration of the employment, and the causes and method of its termination. And in such a case, even though they had made no express agreement, the law would imply that the teacher might be lawfully dismissed for immoral conduct, incapacity, neglect of duty, or failure to comply with the obligations imposed by the contract.

It is common, however, for the statutes to expressly stipulate what the terms of the contract shall be in this regard, and what shall be the evidence of such default on the part of the teacher as will justify his discharge.

Thus where an examination is provided for, and a certificate is to be issued, by some public board or official, as in this State, provision is often made for the suspension or revocation of the certificate by the same authority, and the contract is required to contain a stipulation that this suspension or revocation shall terminate the contract. Under provisions of this nature, the district authorities possess but a limited power of arbitrary removal.

In a case in this State, where the statute provides that the board of school examiners may suspend or revoke any certificate for causes which would have justified its refusal in the first instance, and also for neglect of duty, incompetence, or immorality; and the contract contained a stipulation that such a suspension or revocation should terminate the contract, it was held that the district officers had no jurisdiction to pass upon any alleged default

of the sort indicated, or to remove the teacher for such default, but that the question of his guilt and the consequent termination of his contract must be confided to the Board of School Examiners.

It was, however, held that for defaults in other respects than those indicated,—defaults which would at common law justify a master in discharging a servant,—such, for example, as the inhuman treatment of the pupils, the teacher might be discharged by the district board without reference to the suspension or revocation of his certificate.

When the causes for which the the teacher may be removed are thus specified by statute, the courts have held that the power of removal cannot be exercised until the teacher has been notified of the alleged default and has been given reasonable time and opportunity to make a defence. This right is expressly granted by statute in this State.

A teacher who is wrongfully discharged before the expiration of the term for which he was engaged, is entitled to recover damages for this dismissal. Such damages would ordinarily be the amount of the salary for the residue of the term, less any sums the teacher may have been able to earn during that period in other like employment in the same locality.

A teacher though wrongfully discharged would still be under obligation to use reasonable efforts to find another similar position and thus to reduce his loss as much as possible; but he would not be obligated, in order to reduce his recovery, to accept another kind of employment, or to go to other places to seek it.

In a late case in Iowa, a teacher wrongfully discharged just after the opening of the year who had been unable to find any other like position, was held entitled to recover the full year's salary even though he had in the meantime started a private school which had proved to be a financial failure. If it had been successful, he would doubtless have been required to deduct his earnings from the salary he was seeking to recover. Money earned during vacations would not, however, affect his right to his salary, and in one case it was held that the school board might, as part of the contract, permit the teacher to offer extra courses in his school and charge for these an extra compensation which he might retain as his own.

REPORT OF THE COMMITTEE ON COLLEGE ENTRANCE REQUIREMENTS IN ENGLISH, FROM THE STANDPOINT OF THE HIGH SCHOOL.*

CORNELIA STEKETEE HULST.

I shall do my best in fifteen minutes, as your committee requested, to give my firmest convictions on the subject under discussion, and I must pray you to forgive it me if my paper does not say all that should be said. I must make the good old pleas, "My wit is short, ye may well understand," my time of preparation has been very short for so important a subject, and the time allotted is too short to discuss many phases of it.

There are things in the Report of the Committee that make my heart rejoice—corrections of mistakes we have been falling into, appreciations of

* Read at the November meeting.

some needs we have hardly felt, and thus prophecies of better conditions that are still to be.

Perhaps I had better begin with the prophecies, the ideals whose realized substance is still to be hoped for, for our ideals are the most important things about us, since in them we see "the future in the instant," which leads us on. The committee presents first the proposition that "the study of the English language and literature is inferior in importance to no subject in the curriculum." The committee would have been justified in making its statement even stronger, calling the study of our native language and literature the *most* important subject in the curriculum, as the ancient Greeks did. I am not making a plea to restrict our study to the English language and English thought, I am not an enemy to the introduction of foreign elements into our civilization. The Greeks certainly lost by not studying the literature of their neighbors, the Hebrews, and great as their native literature became in some respects it is an infinite pity for all time that it was not inspired to a higher and holier greatness than that of their own gods. But they were wise in preserving the purity of the diction and idiom of their language, and in making their young people thoroughly familiar with their best literary art. However we may widen our curriculum (and, so long as the subjects are thoroughly taught, the wider it becomes the better, to serve individual needs and adopt and preserve and perfect all learning by the introduction of foreign languages, arts, histories and sciences that are worthy of a place by what richness they will give to the thought of our young people, and what appreciation of all that is beautiful) we should guard as jealously as the Greeks did that one language which our pupils are to use, and should teach it for all it can be to them,- a means of getting thought, a means of expressing thought, and a source of refined pleasure. According to their ability to use their own literature, to extract what is to become theirs, and to assimilate it and make it over into power, will be their ability to profit by what comes to them from foreign sources, where all these processes will be more difficult by reason of their being foreign. English has been badly provided for in some of our courses, especially six years' language courses. Unfortunately the study of foreign languages does not, and can not, take its place, and leaves the pupil at the end of his High School course, confused, sometimes doubly confused, in his vernacular and unconscious of the qualities of a good style. It does not better the matter that a pupil leaves us unappreciative in two or three different languages, to be a bungler in English all his life unless he is so fortunate as to go to college and give his professors a chance to do what we did not do for him in the High School. And even if he enters college his loss is irreparable. If there he elects considerable English (and not all students do so), he does not take it as a High School pupil would. He has grown more analytical, perhaps, and will be better able than when he was in the High School to see and describe points of style, but he will be less unconscious and receptive

and, I venture to say, less profoundly and permanently affected by the substance and the language of what he reads. If he has not read Bunyan before he enters college, he will never, probably, march at Pilgrim's side to the Holy City, although he will understand Bunyan and appreciate his style. Our High School pupils, with unregulated feelings but half understood, are blindly trying to feel out the very problems of life treated of in our great literature. That literature helps them to interpret themselves to themselves. They are sensitive to it as they will never be again, and they need it, I think, as they will never need it again. Chaucer and Spenser and Shakespeare and Wordsworth—let such as these be the masters that show them life and teach them language and literary art, and we shall see great results for our labor. Wordsworth is right in saying that the youth still is nature's priest. Can he as a man come to appreciate our "mountain peaks of song" if he has never seen them until the splendor of his own early morning is fading into the light of "common day"? What shall we say of a system that forces books into the hands of our youth filled with diagrams, and paradigms, and scholia and what not, and provides much less time for the study of the books of life, written by the men who best understood the human heart, the power of nature, and the English tongue? I have dwelt so long upon the other values to be derived from the study of great literature that I have not emphasized sufficiently this last very practical one. The Report reminds us that for the pupil "his own tongue must always be the chief source of his thought, inspirations, ideals and æsthetic enjoyment, and must also be the vehicle of his communication with his fellowmen."

This brings me to the second point in the Report, which seems to me very well taken, especially since, if one may judge from the text-books of Rhetoric that have issued from the press these last years, the study of composition seems to have encroached more and more upon the study of content, form and style, which we might call Rhetoric proper. I think that however good a method this may be for advanced students it is not good for our pupils. It does not seem probable that we can secure a very "clear, logical, convincing and agreeable manner" without "sympathetic and comprehensive appreciation" of our masterpieces. A pupil who has come to appreciate Chaucer will be less likely than one who has not to write bombast. Even Bunyan knew one masterpiece well, if not consciously and analytically at least in his innermost consciousness, and so that he could put his knowledge upon tap whenever he had occasion to use it. Inductively from the writings which are perfect, or nearly so, under the guidance of his teacher a pupil will form his canons of literary style, useful to him not only in making him scornful of anything that is not good and appreciative of anything that *is* good, but also in moulding his own thought into forms effective and beautiful. Unconsciously children learn to talk, unconsciously they should learn sentence forms. Ears that have become attuned to the lovely poetical and prose rhythms of our best

writers will be the surest guides to the creation of smoothly flowing sentences. I often find that if their minds are well stored from wide reading pupils do really good composition work though they cannot answer my questions on the reasons they should have. Of course I believe that it is our work to bring into the field of consciousness a large part of the composition process, that our pupils may not only be right but know that they are right; but I have very deliberately come to the conclusion that in high school English, if either part of our work is less important than the other, it is the Composition. The hardest thing I have to do is to teach fitness to a pupil who has no sense of fitness, or has such a sense rudimentary but not properly cultivated. Until the study of masterpieces has given him ideals and standards of measure to apply to his own productions, until a *feeling* for fitness has formed within his mind, it is next to useless to make corrections in his work, piling precept upon precept. I send pupils who are hopelessly awkward in their use of language to read Treasure Island and Lorna Doone, and unite with this the instruction to write as if for a friend five years younger than themselves. I know of no better way. The influence of the great authors upon our pupils is incalculable, for just as evil communications corrupt good manners, good communications improve them, results often accruing that are far beyond what one planned for, out of the recognition of strength in a great author and of weakness and wandering to be overcome in themselves grow not only strength, but also high reverence where reverence is due, deep humility where humility is due, and a self-respect founded upon conscious rectitude when progress is made. Indeed, in what I have just said I have reversed the process of growth into strength and grace, for I believe that strength and grace of style are an outgrowth of character, unless, indeed, they are assumed (in which case, being mere pretense and affectation, they should be called rather "airs" than "graces" of style). The pupil who has read such a work as the Prologue appreciatively, who has analyzed the characters described and found the reasons why Chaucer ridiculed or did not ridicule them, as the case happened to be, and why he liked them, disliked them, or was indifferent to them, has discovered in Chaucer's own sincerity, simplicity, scorn of pretension and admiration of worth the very sources of the most patent charms of his style. From their admiration of Chaucer our pupils will tend to acquire his character, and hence his style. It is altogether better teaching to cultivate in them admiration of simplicity and sincerity than to teach them to write *as if* they were simple and sincere. Teaching by the great authors is teaching by example.

The committee is right, surely, in requiring that the subjects (and I take it that this applies to subjects for essays as well as to subjects for study) should be such as are "in themselves dignified and elevated, taken from the higher or spiritual environment of the pupil, as found in his school work, and from the environment of his home life." It is a pity to tie him down to de-

scribing literally the street he lives in, or an alley near by, when he might just as well describe the Garden and Palace of Alkinoös as Odysseus saw them, the character of Brutus as Shakespeare represents it, the politics of William the Silent and George Washington as he has studied them in history, or the struggle of the Transvaal for its Independence as he tries to follow it in the daily paper. A boy who ought to have been an excellent student told me that he did not like his composition work because it was too tame, there was nothing heroic about it. Another said that when he was in school his teacher did not care about what was said, but only how it was said, and that most frequently the thing said was not worth saying. The committee's recommendation tries to rectify the mistakes we have been making. On the choice of subjects our success depends very largely, and according to them we shall have live and willing work or dead grind and shirking.

Appreciative as I am of these things in the Report, there is one respect in which I feel that it fails to satisfy our needs. The High School course in English should be very carefully planned, and the teaching should proceed systematically, logically, so that when the end is reached an edifice will have been completed of which the plan is perfectly clear in the mind of the pupil, as in that of the teacher. It is not sufficient that pupils should read certain master-pieces selected simply because they are great, higgledy-piggledy. The selection should be so made that it includes the great types of literature, and these should be presented in such an order that when the course is finished there shall be left with the pupil as strong a sense of the time and growth of those types as of their inspiring contents, beautiful forms, fit words, and distinctive styles. In mathematics and history attention is paid to the development of the subject, one part preparing for the next, as it is seen in the light of the preceding. Anyone can see that in history it would not be well to skip from century to century, from the Reformation back to the Age of Pericles, from the Unification of Germany, to the Monastic System of the Middle Ages. But this is the sort of thing we are expected to do in English, leaving yawning chasms between our parts never to be filled at all. Narration, one of the most difficult forms of writing to analyze and one of the latest to develop, is to be taught in the 9th grade. Not to make a fetich of the biological argument, I think the epic should, as in the race's history, precede the other forms of narrative. The Odyssey is very much easier than, for instance, Ivanhoe, which is as complicated in its structure as a five act play with three or four minor plots to follow. A half year in the 9th grade spent in reading the Odyssey ought to give the pupil a start in the history of literature, in the study of plot, of description, diction, style and versification, while it exercises him in composition on a great variety of subjects, such as descriptions and comparisons of places, ceremonies, manners, characters, political organization of the state, religion, ethics, etc., and while it prepares him to take other forms of literature as they come, by the study of (1) their meaning, or contents, (2) form and (3) style, as the Committee requires.

Lyrical and dramatic poetry, also, should precede prose narrative for the same reasons. The studies of diction, of description, of figures, of harmony and all the other devices to make writing effective should be synchronous with the studies of form and of the subjects which the writers present. These studies are delightful and very profitable if they are not made studies of detached details to be conned out of a text-book, but appreciated and described and defined as they occur, beautiful or effective parts of a living whole. When a text-book is used it should be as a means of systematizing and clarifying the new ideas which pupils have been acquiring. The great danger in the use of a text-book is that through its use pupils may be set to *learn about* things, at second hand, which they should be acquiring directly from their reading, and so may fail to profit by training in observation, and judgment and generalization. If, now, the methods of description and the construction of the plot are noticed in all the successive pieces of literature as they are studied, in the epic, the ballad, the metrical romance and the play, is there any need of studying narrative for one half year and description for another? Very frankly, I think this would be a waste of precious time, and would be making the great mistake, besides, of treating as an *end* what should be studied only as a *means* in our courses. A few weeks spent on the tale and the novel toward the close of the course in which there has been thorough training on the preceding types, would be more effective than a year spent on the methods of narration and description without such previous training.

My conclusion is, then, that, while approving entirely of the aims and principles of the Committee's Report, I cannot wish or recommend the adoption of the course as it is outlined by the committee. We must try to accomplish the results asked for, the solution in our high schools varying according to the time allotted for the study of English in our different courses.

Mr. President, to sum up my remarks as briefly as I can in direct answer to your points specified, it is my opinion that in the High School English work should be:

1. In matter,—the great types of literature studied in succession, so as to preserve a proper historical perspective, and so as to fix in the memory of the student (a) the meaning of the author, his subject, (b) the structure of the piece studied, and (c) the style. This study should raise questions in literary criticism that later research may answer, and parallel with this largely inductive study should be composition, to secure to the pupils accurate and effective expression and good form for their own thoughts.

2. In manner,—such as aims to awaken the pupils' sympathies, to appeal to their imaginations, to exercise their judgments, and to fix in their memories the prime facts concerning the great types of literature and the styles of the great masters and schools of literary art. Reading and discussion of the masterpieces themselves seems to me the best method of accomplishing the results

we seek, following a carefully constructed outline, and making use of a text-book only so far as it will assist in systematizing instruction and adding definiteness to it. Criticisms of literature should not be studied by pupils before they have read the literature which called forth the criticism, and may very well be left until the end of the course, or until they enter college. It should be the teacher's part to make pupils think, to give them a method of work, and to raise questions to be kept in mind pending a soulution; and the teacher's own method should be largely Socratic. I think about half of the study time may well be set aside for individual reading upon assigned authors, and about half of the time devoted to the subject be given to composition.

3. In equipment,—rich in books and pictures, both of such sort as bear upon the subjects studied. I find that my pupils have become much more familiar with Wordsworth since we have some photographs of his home, his haunts and his grave, than they used to be before we had them, for in those pictures they have seen his ideals. Anecdotes, like those in the volumes called Personal Traits of the British Authors, published by the Scribners, add very much to their understanding of the men they study.

4. In time,—four hours a week for four years. As I said, our courses which prepare for the university are at present the weakest in English, and most of what time is given is in the 9th and 10th grades, when the pupils are immature. The demand for more time to be given must come from the colleges. It is my hope that this will be the one subject on which all factions of the University faculties will agree, in order that students may come to the Universities rich in vocabulary, and idiom, and free and accurate in the arts of speaking and writing. With too little time we must expect indifferent results.

THE TEACHING OF ENGLISH LITERATURE.

EXTRACT FROM A PAPER BY PROFESSOR M. W. SAMPSON OF THE UNIVERSITY OF INDIANA.

An elementary study of *Silas Marner* may be made in this fashion:

The sequence of events in the story is a tangible thing. What is the bearing of each thing that happens? What effect has it upon the following event? Was it caused by the preceding event? By asking such simple questions as these, even the immature student will begin to perceive relationships, and, with a little judicious guiding, will mark that nearly everything that happens is necessitated by the characteristics of persons, or else results in the further development of characteristics. Thus the first marriage of Godfrey means Dunstan's arrogant control over him, and this means the selling of the horse, and this Dunstan's heedless ride, and this the robbing of Silas Marner, and this the finding of Eppie. Again, Silas Marner's loss of

guage, quarreling and fighting among each other,—these and many other similar and obvious acts the teacher may prohibit and punish.

So, in regard to the studies to be pursued, the teacher may, where no rules are prescribed by the board, exercise a reasonable discretion "as to the order of teaching them, the pupils who shall be allowed to pursue them, and the mode in which they shall be taught;" but the teacher shall not compel a pupil to pursue a study which he knows the parent has forbidden his child to take.

The authority of the teacher is not confined to the school-room or grounds, but he may prohibit and punish all acts of his pupils which are detrimental to the good order and best interests of the school, whether such acts are committeed in school hours or while the pupil is on his way to or from school, or after he has returned home.

Upon the question of the teacher's control over the pupil out of school hours, and off of the school ground, a New England court forty years ago laid down these rules, which, while savoring somewhat of New England rigor, have never been elsewhere questioned.

It was conceded that the master's right to punish extended to school hours, and the court said there seemed to be no reasonable doubt that the supervision and control of the master over the scholar extended from the time he leaves home to go to school until he returns home from school.

After his return home, the pupil comes again primarily under parental discipline, but even in such a case the court declared that if the act done, though at home, had a direct and immediate bearing upon the welfare of the school or upon the authority of the master and the respect due to him, the master might punish the scholar if he came again to school.

For the purpose of maintaining the order and discipline of his school, the teacher, it has been held, has the inherent power to suspend a pupil from the privileges of the school, unless he has been deprived of that power by the affirmative action of the proper board. If he so suspends a pupil, he should at once report the fact with the reasons to the board.

But while the teacher may thus suspend a pupil, he has no inherent power to finally and entirely expel the pupil. That power belongs properly to the board, unless by statute, or other regulation, some different rule has been enacted.

Upon the vexed and vexatious question of the right of the teacher to inflict corporal punishment, it is not easy to lay down positive rules. It is clear enough to any one that the public sentiment in regard to the subject as it affects home and school discipline, has greatly changed in recent years, and is still in an unsettled condition. This change in public sentiment is certain to make itself felt in legislation and in the decision of the courts. In many places, rules have been enacted forbidding the infliction of such punishment by others than the principal. Up to the present time, however, the courts have uniformly sustained the right of the teacher to inflict reasonable corporal punishment.

In dealing with the question the court in Vermont, in a somewhat early case, laid down rules which have been quite generally approved. Said the court:

"A school-master has the right to inflict reasonable corporal punishment. He must exercise reasonable judgment and discretion in determining when to punish and to what extent. In determining upon what is reasonable pun-

ishment, various considerations must be regarded,—the nature of the offense, the apparent motive and disposition of the offender, the influence of his example and conduct upon others, and the sex, age, size, and strength of the pupil to be punished.

"Among reasonable persons, much difference prevails as to the circumstances which will justify the infliction of punishment, and the extent to which it may properly be administered. On account of the difference of opinion, and the difficulty which exists in determining what is a reasonable punishment and the advantage which the master has by being on the spot to know all the circumstances, the manner, look, tone, gestures, and language of the offender (which are not always easily described), and thus to form a correct opinion as to the necessity and extent of the punishment, considerable allowance should be made to the teacher by way of protecting him in the exercise of his discretion.

"Especially should he have this indulgence when he appears to have acted from good motives, and not from anger or malice. Hence the teacher is not to be held liable on the ground of excess of punishment, unless the punishment is clearly excessive, and would be held so in the general judgment of reasonable men. If the punishment be thus clearly excessive, then the master should be held liable for such excess, though he acted from good motives in inflicting the punishment, and in his own judgment considered it necessary and not excessive. But if there is any reasonable doubt whether the punishment was excessive, the master should have the benefit of the doubt."

In a late case in New Hampshire, it appeared that a school teacher had been annoyed by repeated unnecessary coughing among the pupils; and he requested its cessation. It continued, however, and on one occasion while the teacher was in the midst of an expostulation against it, a pupil coughed. The teacher, interpreting this as an act of defiance at his request, inflicted some moderate personal chastisement upon the pupil. The pupil, claiming that he was affected with whooping cough and that the cough in question was involuntary and beyond his control, sued the teacher for assault and battery. The trial court instructed the jury that even though the pupil's claim was true, the teacher would not be guilty if he, in good faith, believed that it was a voluntary act done for the purpose of defying his authority and disobeying the rules of the school. Upon appeal to the Supreme Court of the State this ruling was affirmed, the court saying: "The law clothes the teacher, as it does the parent in whose place he stands, with power to enforce discipline by the imposition of reasonable corporal punishment. He is not required to be infallible in his judgment. He is the judge to determine when and to what extent correction is necessary; and, like all others clothed with a discretion, he cannot be made personally responsible for error in judgment when he has acted in good faith and without malice."

The teacher also owes some duty, not yet clearly defined and fortunately not often called in question, of protecting the children under his care against injuries resulting from their helplessness and inexperience. To some extent, for a limited time, the teacher stands in *loco parentis*, and while it has never been decided, so far as I am aware, how far the teacher is, or should be held, responsible for either physical or moral injuries to the children which the teacher might have prevented, I feel very sure that we shall all agree that both law and morals should require the exercise of reasonable care and fore-

themselves of every possible means to maintain their standing in the world's market. For nearly a century England was able to control the larger share of the world's trade through the genius of her merchants. But genius can not stand against scholarship. Both Germany and France have undertaken to develop commercial abilities among their people by a systematic scheme of education and there is no doubt but this has met with a considerable degree of success. One explanation of this tendency is doubtless the pressure of international competition.

A second explanation of this universal movement toward higher commercial education is found in the trend of modern industry toward concentration, in the increasing complexity of business affairs due to the development of the world's market, and in the fact which is of peculiar significance for the United States, that the development of foreign interests incident to the establishment of a colonial system is sure to bring with it an increase of foreign commerce. It is essential that the modern industrial organization should be understood by those who are entrusted with its administration, that the relation of business life to other forms of social activity should be appreciated, that the social as well as the political tendencies involved in business organization should be comprehended. This can not be done except as the result of study and analysis and the only period when such study and analysis is possible is the period during which our universities claim the attention of young men.

It is not possible to speak extensively respecting the lines of instruction which such a course of study would include. The backbone of this instruction must be found in political economy for this is the science that deals with industry and commerce. Speaking concisely, I should say that a course of instruction designed to give a scientific insight into industrial society must consider first the nature of man as an economic agent and the laws by which his actions are controlled; it must investigate, second, the physical conditions of the world which determine the localization of industry and the course of trade; it must, in the third place, analyze the lego-historic features of life by which the rights and duties are expressed and conduct limited and directed; and finally, it must study the principle of voluntary association and seek to understand the personal and social results of various forms of organization, that is to say, a course of higher commercial education must include a study of political economy, of economic geography, of history and of law and of the principles of industrial organization. The attainment of such knowledge by business men would stamp the business man as a scholar and warrant the recognition of a business career as a profession. And I venture to add that any curriculum of study put in force by an university less comprehensive than the one thus indicated makes an improper use of the phrase higher commercial education.

The chief advantage of a commercial education may be regarded either from the point of view of the student or of society. The chief advantage which the student may expect to derive is that the training which gives insight into industrial conditions will extend for him the limits of possible promotion. The difficulty of an untrained mind is that it exhausts early in life its capacity for growth and development. A young man cannot expect that a commercial education will excuse him from work, that he can pass at once from the university to the direction of important business interests, but he may expect as the result of his special training, that greater interests and

responsibilities will ultimately be placed under his control. Corporations are ever on the lookout for men who by virtue of their education and attainments are capable of assuming the highest responsibility.

The public advantage in higher commercial education is found in its influence upon life and character. The business world at present is suffering under the absence of responsibility. Industrial power is administered in utter disregard of the principle of social service. Intelligent insight on the part of business men into the essential nature of business organization and into the relations which exist between the industrial organization on the one hand and the political and social organization on the other, will tend to realize what Thomas Mun of London, Merchant, writing in 1628, said, that the merchant is the "steward of the kingdom's stock."

REPORT OF THE BIOLOGY CONFERENCE.

SECRETARY'S MINUTES.

The Biology Conference assembled Friday afternoon in the Museum lecture room, Dr. Frederick C. Newcombe, of the University of Michigan, acting as chairman. Miss Helen King, Saginaw, E. S., gave the first paper, an illustrated lecture on the Jardin des Plantes at Paris. The session then adjourned to Room 2, where there were on exhibition note-books from various schools in the state, and charts and apparatus illustrative of experiments.

Miss Frances Stearns, Adrian, was named secretary. The following papers were presented: 1. One Way of Presenting the Principles of Organic Evolution to High School Students, Dr. Lewis Murbach, Detroit; 2. The High School Course in Zoology, Dr. S. J. Holmes, Ann Arbor; 3. Relation of the High School Teacher to Nature Study in the Grades, C. C. Lemon, Detroit; 4. The Amount and Preparation of Microscopic Work, Hester Fuller, Greenville; 5. Devices for Illustrating Plant and Animal Functions, S. O. Mast, Holland; Lewis Murbach, Detroit; B. J. Howard, Pontiac.

Professor Volney M. Spalding not being present to conduct the round-table which was to have formed part of the programme, some time was spent in an informal discussion conducted by the chairman, and in examination of note-books from the three Detroit schools, Saginaw, E. S., Ann Arbor, Pontiac and Adrian.

In the business session which followed the presentation of papers, the following resolution was adopted: "Resolved, That the executive committee be empowered to arrange, if possible, to have the meetings of the Biological Conference and the Michigan Academy of Science for next year at the same place and time and in joint session."

The officers named for the ensuing year were: F. C. Newcombe, chairman; Frances Stearns, secretary; Paul Cowgill and Margaret Merrill, members of the executive committee.

FRANCES STEARNS, Sec.

ONE WAY OF PRESENTING ORGANIC EVOLUTION.

BY DR. LEWIS MURBACH, DETROIT.

This is to be a blackboard exercise with the Botany class. Soon after the student has some knowledge about plants,—their nature as living beings made up of protoplasm, capable of stimulus and response in all conceivable ways, he is ready for this simple lesson. We begin with the idea that all plants were at one time simple and nearly alike. They would then be in the same condition as men in a city who all had the same trade or occupation. In answer to the question, "What would take place among plants so situated?" the pupils will probably say that the difficulties of living would bring about a struggle, or competition. We put this on the board as one of the factors in the shaping of the future kind of plants. Then in answer to

the question, "What will happen to many of the struggling individuals?" the answer, "crowded out" or "dispersed" may be formulated. This is put down as our second topic. The pupils can readily see that this dispersal will subject the plants that have been crowded out to new conditions; a bog or marsh plant will be on dryer land, or the reverse will take place with the upland crowfoot. "What must these plants be able to do in order to succeed?" "They must be able to change," and this may be put as the third factor in the making of plant kinds, with the word "variation." "Why can living organisms alone vary or have ability to change?" The pupil is now as nearly prepared as he can be to learn that variation is the most important factor in the origin of any new kind of organism (plant). "Being able to vary (so that a land plant being gradually surrounded through succeeding ages by more and more water will have certain variations in its structure), what must the plant do further to succeed in its new surroundings?" The general answer of all pupils taken together, "that they must suit themselves to the new conditions" will readily be translated into the scientist's expression, adaptation, and we have the fourth step in the origin of new kinds. Here a few sub-topics may be developed by the question, "To what natural surroundings must the plant first adapt itself?" "After having adapted itself to climate and soil, from what natural enemies has it to protect itself?" "With what weapons do plants protect themselves from other plants and animals?" All of these answers may be put in topic form under the head of adaptation and each may be further developed.

"To what do successful struggle and adaptation lead?" will bring the answer that "the stronger or successful ones will be perpetuated," and this we put the last or fifth step, the survival of the fittest.

These being now written in topical form on the board, the teacher can further elucidate and develop each one.

THE RELATION OF THE HIGH SCHOOL TEACHER TO THE NATURE WORK OF THE GRADES.

BY C. C. LEMON, DETROIT.

Two problems confront the teacher in the grades of the public schools. The first, is the relation of nature study to the other studies of the grades: the second, is the relation of nature study to the high school course. Only the first question will be considered in this paper.

We are forced by circumstances and conditions to recognize three periods in the nature study course. First, the nature study period, as we will call it, in which we try to lead the children to see, experience, and love nature as do John Burroughs, William Hamilton Gibson, and others. Many teachers, through inexperience, attempt to substitute science for nature study, even in the first two grades of the course. Here is an excellent opportunity for the high school teacher to exert an influence, by coming in contact with the children and with their teachers. Second, The period in which the geographical idea, as Professor McMurry calls it, takes precedence. This period includes the third, fourth and fifth grades, and the work done in it goes to broaden and strengthen the work in geography. The greatest needs of the work of this period are accurate scientific knowledge on the part of the teacher and skill in illustrating by simple experiments the facts

taught. If the high school teacher were willing to supervise this work, much could be done to rid nature study of the myth and fairy and to eliminate many false ideas, which have done more to prejudice the public mind against nature study than all things else put together. Third, the period of concrete science, which includes the work of the sixth, seventh and eighth grades. For these grades practically nothing has been developed as yet. Here again the knowledge and experience of the high school teacher may be of value to the nature study of the grades not only by helping to decide what work may be done profitably, but by aiding the teachers or even teaching the science work of this period.

The high school teacher can exert an influence upon nature study which will be of lasting good to the graded schools, and will bring the pupils to the high school richer in knowledge, quicker in the use of their senses, keener in perception, and more acute in their powers of discrimination.

THE AMOUNT AND PREPARATION OF MICROSCOPIC WORK.

BY HESTER FULLER, GREENVILLE.

Every phase of life and habit of thought has had to be adjusted to science, and its claims in secondary education are now universally recognized. The question in regard to botany now is, How shall it be taught, and how much can be accomplished in the short time allotted to it?

To answer this question, it is necessary to have a definite idea of the place of Botany in education, and of the results to be obtained by its presentation. More time should be given to botany in the high school, or else the nature study of the grades should be made sufficiently effective to serve as a thorough preparation for high school work. If only one semester can be devoted to botany, it seems unwise to begin with the study of objects too minute to be seen by the unaided eye. It is only after the mind has been trained to interpret, with unprejudiced impartiality, what the eye sees, that the microscope can be used with profit. Text-books and microscopes are only a means to an end, and should not be regarded as an end in themselves. The most important consideration is a teacher who knows how to go to the heart of things.

High school botany has nothing to do with particular phases of the subject, but should aim to secure the greatest possible degree of mind training by scientfiic methods, and should give, as a permanent possession, a knowledge of plants as living organisms, whose structure is related to and interpreted by function. This, together with some study of types and of classification, from the point of view of relationship, will furnish a basis for further study and add an element of culture to education.

A CONVENIENT PIECE OF APPARATUS FOR DEMONSTRATING SOME PHASES OF PLANT RESPIRATION AND CARBON ASSIMILATION.

BY S. O. MAST, HOLLAND.

The apparatus consists of a series of bottles, A, B, C, D, E and G, and a bell-jar F, connected with rubber stoppers, glass and rubber tubes, arranged as indicated in the accompanying figure. Mercury or water is put into the basin containing the jar, in order to make it air tight.

The following experiments may be performed:

1. To prove that germinating seeds give off carbon dioxide.
2. To prove that fungi give off carbon dioxide.
3. To prove that green plants in the dark give off carbon dioxide.
4. To prove that green plants consume CO_2 in bright light.
5. To prove that green plants require CO_2 for growth.
6. To prove that green plants give off oxygen in bright light.
7. To prove that germinating seeds require oxygen for growth.
8. To prove that fungi require oxygen for growth.

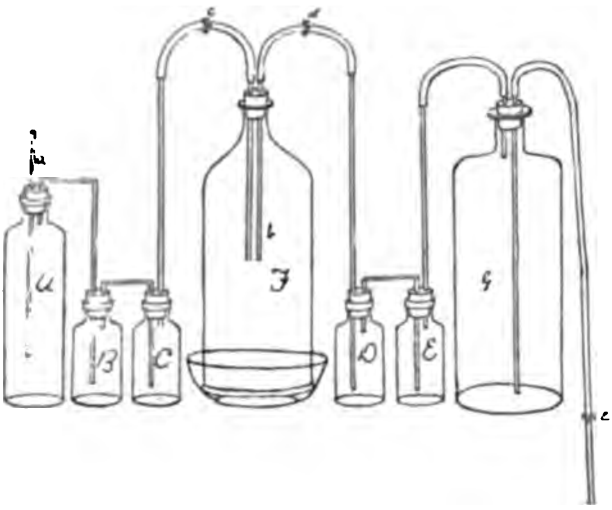

Fig. 1

In every experiment the large bottle G is filled with water, which is withdrawn by means of a siphon, as indicated in the figures, the rate of flow being regulated by the clamp *e*. The water withdrawn by atmosphere pressure is replaced by air, which must enter the glass tube *a* and pass through the entire series of vessels to G.

In the first five experiments the bottle A is not necessary. In Experiments 1-3 the plants are put into the bell-jar, or a large-mouthed bottle in place of the bell-jar, and the bottles B, C, D and E are filled about half full of barium hydroxide or calcium hydroxide in solution. At first the vessels F and G are directly connected and air is forced through the series. As it passes through the solution in B the carbon dioxide is absorbed When

F no longer contains carbon dioxide, D and F are connected as represented in the figure. If now any carbon dioxide is formed by the seeds, a white precipitate will appear in D.

In Experiment 4 a large plant, which nearly fills the bell-jar F, should be used. After the plant is under the bell-jar, F and G are directly connected and air forced through the series, B and C containing barium hydroxide, or any other substance which will absorb carbon dioxide. When it is thought the air in F no longer contains carbon dioxide, D and E are connected or filled with water. The air must now be allowed to pass through the series very slowly and the plant put into sunlight. If no precipitate appears in D the plant has consumed the carbon dioxide of the air, which passed through the series.

In Experiment 5 air is forced through the series connected as represented in the figure, bottles B, C, D and E, containing some substance that will absorb carbon dioxide. It is also well to slip a few pieces of solid potassium hydroxide under the bell-jar containing the plant. If the plant dies its death must be due to lack of carbon dioxide.

Experiment 6 may be performed with either land or water plants. If water plants are used, a large, wide-mouthed bottle, or an ordinary fruit-jar may be used in place of the bell-jar. If the bell-jar is used, all connections are made as represented in the figure. The bottles A, B, C, D and E are partly filled with water, the plant put under the bell-jar without any mercury in the vessel containing the bell-jar. Air is then forced through the series, and water, which may first be boiled to eliminate oxygen, poured into the basin containing the bell-jar. The tube b is withdrawn to the level of the lower surface of the rubber stopper. The water containing the plants will rise in the bell-jar, which may be completely filled by lowering the glass tube *a* in the bottle A. After the bell-jar is full of water, clamps *c* and *d* are closed. The water in bottles A, B, C, D and E is now replaced with a solution of pyrogallic acid, which absorbs oxygen very readily, forming a brown precipitate. Much care should be exercised in order to expose the solution to the air as little as possible. Air is now forced through the series, first for a short time with F connected directly with G, then very slowly with D and E in the series, as represented in the figure. If a brown precipitate appears in D, the plants must have given off oxygen. If land plants are used, the procedure must be modified to suit the case.

In experiments 7 and 8 any of the above methods may be used to eliminate oxygen, and results looked for.

DESCRIPTION OF THREE EXPERIMENTS IN PLANT PHYSIOLOGY.

BY DR. LEWIS MURBACH, DETROIT.

Three experiments in plant physiology, from the Detroit Central High School, were shown by chart. The first was to show how a simple auxanometer can be made with any clock; the essentials being a cheap clock (lever movement), or better an eight-day clock, a wood cylinder, or a drum of tin or pasteboard, and a frame carrying a pointed marker in such a position that it can travel vertically along the side of the cylinder when the latter is in position. Finally, a reducing pulley over the marker. See Fig. 2.

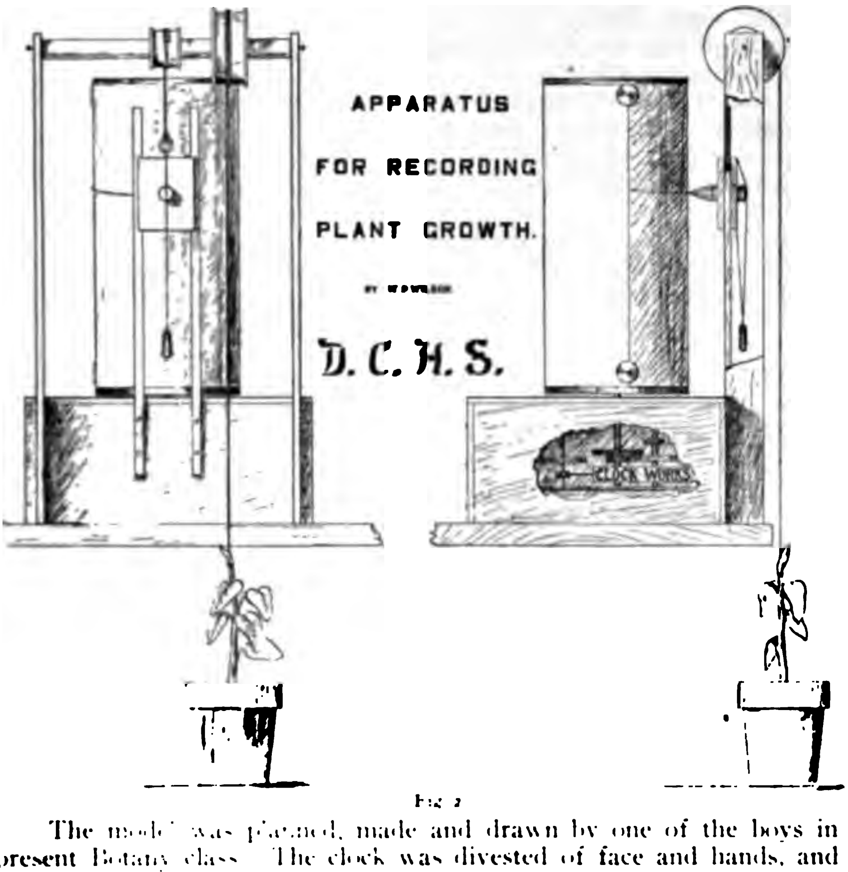

Fig. 2

The model was planned, made and drawn by one of the boys in the present Botany class. The clock was divested of face and hands, and the cylinder fastened to the thimble of the hour hand wheel. Thus the cylinder revolves once in twelve hours. A string from the growing end of the plant is passed over the smaller pulley and fastened; then a string passes over the larger pulley and down to the marker. It will readily be seen that, while the plant grows, the marker will descend on the side of the cylinder, and the result of the two motions combined is the rate of growth of the plant at

different hours of the day. It simply remains now to fasten a piece of smoked paper to the cylinder, or better, to smoke the paper on the cylinder with an oil lamp.

By placing a pot of seedlings on a cork platform fastened to the pinion of the minute hand, the same instrument may be used for counteracting the effect of one-sided illumination. See Fig. 3.

A short test tube filled with soaked seeds and saw-dust may be attached by piercing the cork of the test tube with the minute hand pinion. The clock will then turn the test tube rapidly enough to counteract gravity.

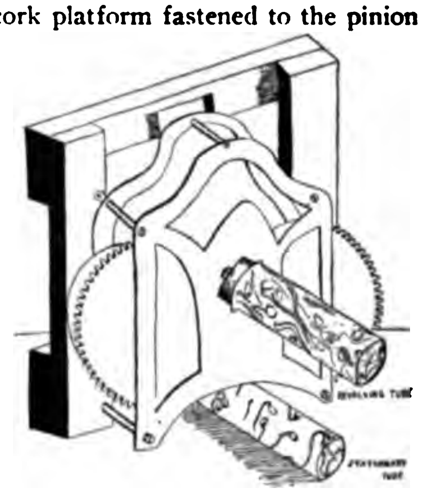

Fig. 3.

The other two charts (not here illustrated) represent root experiments. In one are shown three views of a test tube which had been loosely filled with saw-dust and soaked seeds. As soon as the roots of the germinating seeds had grown, the test tube was inverted and left until the roots turned and grew down again. Then the tube was placed in the first position, compelling the roots to turn a second time.

The third chart shows a modified form of the old experiment for illustrating hydrotropism of roots. The first figure shows seedlings growing in a net of wet saw-dust in a container covered at the top. The second figure shows the position of the roots one day after the water had been removed from the basin below.

THE HIGH SCHOOL COURSE IN BIOLOGY.

BY DR. S. J. HOLMES, ANN ARBOR.

At the present time there seems to be, in many places, a reaction against the morphological work which has often constituted the main feature of the biological instruction of the secondary schools. Most of the laboratory manuals designed for use in the schools are almost exclusively devoted to the structural side of biology. But it is coming to be felt that the dissection, drawing, and description of a certain number of typical forms does not constitute an ideal biological course. Students of the age of most high school pupils have little interest in morphology as such, and they are as a rule unable to appreciate the morphological problems that appeal to the more advanced student. They have, however, a sympathetic interest in living nature. Facts concerning the habits and life histories of organisms are eagerly sought for and easily assimilated. A morphological course gives a foundation for future biological work, but it is a foundation upon which too often nothing is built. It does not afford an interest which will lead to future work after the student leaves the high school. The student has a lot of knowledge about the structure of a half dozen or more distantly related types, most of which is unassimilated and consequently soon forgotten. But after leaving school he does not voluntarily seek knowledge along morphological

lines, and his mind has not been opened up so that he will seek biological knowledge along other lines.

Yet morphological work cannot well be eliminated from the high school course. It affords a valuable training that should not be dispensed with. But it should not form the main object of the work, as it has for the student little interest for its own sake, though a certain amount of morphological knowledge may be necessary to the comprehension of thingss that are of interest to him.

A SIMPLE TEST FOR OIL.

BY B. J. HOWARD, PONTIAC.

We found in our laboratory work that the method of using benzine or ether, given in some of the text-books, is of use only for seeds which contain a large amount of oil. I have found that by crushing a seed within a told of some rather thin writing paper, if there is oil present, even in small amount, a grease spot will appear which is easily seen when the paper is held to the light. If there is any question as to whether the spot is due to oil or water, if it is allowed to stand for a few minutes or warmed over a flame, the water, if such it is, will of course evaporate.

By tabulating the results of tests for starches and oils, as shown below, the student is usually pleased to note that where starch occurs in large amount, oils are lacking, and vice versa.

KIND OF SEED	COLOR ON ADDITION OF IODINE	AMOUNT OF STARCH	AMOUNT OF OIL
Corn	Black Blue	Large Amount	None
Wheat	Black Blue	" "	"
Squash	Light Blue	Small Amount	Medium Amount
Walnut	Yellow	None	Large Amount
Hickory nut	Yellow	"	" "
Horse Chestnut	Dark Blue	Quite Large Am't	None
Oats	" "	" " "	"
Pea	" "	" " "	"
Bean	" "	" " "	"
Rice	Black Blue	Large Amount	"
Peanut	Yellow	None	Large Amount

REPORT OF A CONFERENCE OF PHYSIOLOGY TEACHERS IN SECONDARY SCHOOLS.

PRESENTED BY DR. LEWIS MURBACH, DETROIT CENTRAL H. S.

In one of the short papers read at the meeting of the Schoolmasters' Club in November, 1899, attention was called to the apparent neglect of physiology in secondary schools, either on the part of the University, as required for entrance, or by the authorities of the high schools, as useful for training and necessary knowledge. This state of affairs is in part, at least, due to the misconception that physiology cannot be taught as a laboratory study in such schools. The greatest opposition in the high school itself generally comes from disagreeable criticism of thoughtless people about the "bloody sights." It is our mission to correct these impressions, and to help each other by our experience and co-operation to better and more effective teaching, and the definite recognition of physiology as a laboratory science of equal value with the other two biological sciences. To this end circular letters were sent out from the Detroit Central high school asking for a conference of physiology teachers.

The topics suggested for this discussion were:

1. The place and importance of physiology in the secondary school.
2. The nature and amount of physiology to be taught.
3. What text-book? what part shall it play?
4. A simplified laboratory course.

After each one of these was more definitely outlined as to scope and bearing, they were taken up, one by one, in informal discussion, in which all present took active part. The general trend of the discussions and the conclusions may be seen in the following summary:

1. As soon as physiology can be taught largely by the laboratory method it should be placed on equal footing with botany and zoology. It is of equal importance and should be elective in any course and required in at least the science course.

2. In most schools one term is given to the subject if it is at all represented. At least one-half of the school year should be set aside for the study. In nearly all schools which reported, the parts of the animal body and their functions are taught, illustrated with animals, or parts, from the home or meat-market. In several schools regular laboratory work is done with a manual, similar to that outlined in the fourth topic.

The aversion of pupils and public to the teaching of physiology in secondary schools is ill founded, but sometimes may be traced to causes which the teacher can avoid by the following precautions: not allowing pupils to see animals anesthetized or killed; not presenting mutilated, bloody or unsightly parts of animals; preferably not selecting parts or the whole animal before the class; not inviting pupils "who cannot stand it" to leave the class, as the mere suggestion may have a mischievous effect; using smaller animals, such as white rats.

3. In most schools text-book work is followed by laboratory work, where this is given at all. In some a separate laboratory guide is used, and in others this instruction is given by the teacher.

4. A short extract was read from some laboratory notes used the pres-

ent term, and a laboratory course outlined as given for the past two years in the Detroit central high school. (Practically the same work is done in the Eastern and Western high schools, and in the Adrian high school.) The course includes: The identification of foodstuffs in the more common foods (including milk); a few digestive experiments; simple culture experiments with bacteria and yeast; tests for carbon dioxide, then its sources; acids and alkalis; experiments with muscles and bones; the sense organs from specimen or model, if there is time after the other subjects have been done.

This ground is very thoroughly covered in Peabody's "Laboratory Exercises in Anatomy and Physiology," a little book costing about fifty cents.

It was generally agreed that the two main factors in the successful teaching of physiology by the laboratory method are a trained teacher and some laboratory facilities. The inference is obvious.

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PROCEEDINGS

OF THE MICHIGAN SCHOOLMASTERS' CLUB AT THE THIRTY-FIFTH MEETING HELD IN ANN ARBOR NOV. 30 AND DEC. 1, 1900; TOGETHER WITH SOME PAPERS READ AT THE THIRTY-FOURTH MEETING

Ann Arbor,
University of Michigan
1901

Entered at the Ann Arbor Postoffice as Second-class Matter

MICHIGAN SCHOOLMASTERS' CLUB.

PROCEEDINGS OF THE THIRTY-FIFTH MEETING, HELD AT ANN ARBOR, NOV. 30 AND DEC. 1, 1900.

MINUTES.

The thirty-fifth session of the Michigan Schoolmasters' Club was held at Ann Arbor, Friday and Saturday, November 30th and December 1st. At the opening of the session Principal J. H. Harris, President of the Club, referred briefly but feelingly to the death of Professor B. A. Hinsdale, who had been so closely identified with the work and interests of the Club, and appointed a committee to draft a memorial for presentation to the Club.

The first topic discussed was "The Newly Formulated Entrance Requirements to the University of Michigan," and the discussion was opened by Professor Richard Hudson, dean of the literary department of the University, who explained the new requirements in some detail and justified them as a step in the direction of larger liberty in preparation. The discussion was resumed by Principal J. H. Beazell, of Detroit, who, while venturing to criticise some minor details of the requirements, in the main approved of them as sound and rational.

The second paper of the session was on "The Equipment of the High School Principal," by Principal S. O. Hartwell, of Kalamazoo, a paper conceded by all to be one of the best of the session. Professor S. B. Laird, of the State Normal College, discussed the subject.

The third topic—"The Social Side of High School Life"—was treated in a very thoughtful and thorough manner by Principal R. S. Garwood, of Marshall. This paper aroused more interest than any other of the session, the discussion finally focusing itself upon the subject of secret societies in the high school. The general opinion was that these societies were detrimental to the best interests of the school, although differences of opinion arose as to the best methods of dealing with them. Professor A. S. Whitney, of the University, Superintendent H. M. Slauson, of Ann Arbor, and Principal J. H. Harris, of Bay City, were most pronounced in their

opposition, and in general believed they should be kept out of the high school Principal A. J. Volland, of Grand Rapids, and Principal S. O. Hartwell, of Kalamazoo, felt that secret societies were matters over which the school had no jurisdiction as such, and should simply endeavor to keep them within legitimate bounds.

The Friday evening session was opened by a discussion of the question: "To What Extent Should Collateral Work in the Ancient Languages be Required?" Professor George V. Edwards, of Olivet College, opened the discussion, holding to the view that collateral work should not be directly required of the pupil, save only so much as was necessary to the correct and intelligent interpretation of the text. The teacher should have a great store of collateral knowledge which could be given to the pupil in the way of suggestion and direction, but the crowding of pupils with collateral material to the prejudice of the language study proper, was to be condemned. This topic was further discussed by Professor M. L. D'Ooge, of the University, and by Drs. Meader and Sanders, of the same institution.

The second paper of the evening was entitled "Civil Service in the Appointment of Teachers," and was a vigorous plea for higher grade teaching and for the adoption of those methods of appointment which would bring to a school the very best teaching power available. The paper was by Professor E. C. Goddard, of the University, and the discussion was led by Professor Delos Fall, State Superintendent-Elect of Public Instruction.

At the Saturday morning session the first topic considered was that of High School Statistics, Mr. D. W. Springer, of the Commercial Department of the Ann Arbor High School, contributing the paper. Mr. Springer found that there was great diversity of opinion among schools regarding the kind of statistics secured, and in many instances he found that very little, if any, statistical information was gathered. He set forth in some detail what statistics seemed to him to be of permanent worth.

At the close of the discussion of this topic, it was voted that a committee be appointed to report to the Club at the Spring meeting what statistics it would be desirable for each school to collect, and in what form those statistics might appear.

The next paper of the morning session was on the subject of "Rhetoricals in the High School," and was read by Principal E. O. Marsh, of Jackson Mr. Marsh's general opinion was one of opposition to Rhetoricals as traditionally conducted. The results, he felt, were in no wise commensurate with the amount of energy and effort expended, and while the ability to speak before a body of people was desirable, it might better be cultivated in voluntary organizations like literary and debating societies.

In the discussion which followed it developed that most, if not all, the larger high schools had discarded rhetoricals in the traditional sense of the term, and were either doing nothing along that line, save what might be

done through literary societies, or were making it a part of the English work.

The final paper of the session was on the subject of "Physical Geography in the Program of Studies," and was by Principal L. H. Wood, of Owosso. It was a very complete presentation of the claims of Physical Geography to a place in the high school, with suggestions as to methods of teaching and a discussion of the topics that should be included in the study of the subject, and their order of treatment.

The subject was further discussed by Professor Israel C. Russell, of the University, and others.

At the business session it was moved and carried that a committee be appointed to consider the advisability of holding but one session of the Club a year. This committee is to report at the Spring meeting.

The committee appointed to prepare a memorial on the death of Professor Burke A. Hinsdale reported the following:

The Schoolmasters' Club has heard with a feeling of sadness which it cannot express the news of the death of Professor Burke A. Hinsdale, who, since his connection with the University, has been one of its most active members. His incisive and vigorous utterance, his wise counsel, we shall hear no more. The Club directs that this tribute to the memory of our friend and colleague, this recognition on our part of his wide learning, his vigorous intellect and his tireless labor for the cause of education alike in the class room and in his writings, be spread upon the minutes of the Club and communicated to Professor Hinsdale's family.

R. Hudson,
E. A. Lyman,
H. M. Slauson,
Committee.

The Club thereupon adjourned to meet in the Spring of 1901.

PAPERS.

REQUIREMENTS FOR ADMISSION TO THE UNIVERSITY OF MICHIGAN.

A PAPER READ BEFORE THE MICHIGAN SCHOOLMASTERS' CLUB, NOVEMBER 30, 1900, BY PROFESSOR RICHARD HUDSON, OF THE UNIVERSITY OF MICHIGAN.

The object of the changes recently made in the requirements for admission was to secure greater flexibility. This result has been gained in three ways. Of these by far the most important is the abandonment of the group system. Henceforward the choice is to be between subjects, not between groups of subjects. In other words, the grouping is to be done by the candidate for admission or by the school that prepares him, not by the University. The inconvenience of the group system was that a subject which might be counted in one group was not allowed to be counted in others. Neither English History nor English Literature, for example, might be offered instead of Chemistry in Group 3, although they both had a place in Group 4. Absurd as this rigidity now seems, it did not appear absurd at a time when the course taken in the High School was regarded as the necessary preparation for the course which the student intended to take in the University. A student who found that he had missed his calling might indeed be switched over to another track, but he was required in that case to make up the entrance requirements of the course to which he was transferred. We no longer think that a student should be labelled at the beginning of his High School course for some particular University degree and then carried through in bond. With the sole exception that Latin and Greek must be begun in the High School, if they are to be elected in the University, a student, once that he is admitted, may move freely in the direction of any one of the four degrees. In accounting for the persistence of the group system, it is also to be remembered that certain subjects were very late in gaining [illegible] and that they might be counted fortunate in being allowed to serve as [illegible] among the B. L. requirements.

The second method of gaining flexibility was to reduce the number of required subjects. Under the new system, English, Mathematics, and Physics are the only subjects absolutely required, History and Botany having been made elective. Two units of foreign language work are indeed required [illegible] a choice is given between Latin, French, and

German. The question may be raised whether the Faculty, in reducing the number of required subjects, might not have gone a step or two further. There are many who think that Solid Geometry ought not to be required. The mathematicians, however, insist that Geometry is one subject and that the study of Geometry is entirely inadequate and incomplete if it does not include Solid Geometry.. There are indications that this view is going to carry the day. The state universities have generally followed the example of the University of Michigan in requiring the whole of Geometry. The University of Wisconsin and the University of Minnesota, for example, require Solid Geometry. Columbia University, which last year gave its requirements for admission a thoroughgoing revision, requires the whole of Geometry. In the old Harvard requirements, which are still in force side by side with the new, the requirement in Mathematics was Algebra and Plane Geometry. The new requirements, however, allow the candidate for admission to present either Geometry or Plane Geometry, the former counting as three and the latter as two points. The requirement in Geometry is stated and described in such a way as to raise the question whether the alternative requirement of Plane Geometry is not destined to disappear. With the Western colleges following our example and the Eastern colleges showing a tendency to fall into line, there is certainly good reason for hesitating to make any change in the requirement in Geometry. In behalf of Physics, it may be urged that an education that does not include the study of Science is antiquated, and that the study of Science ought to begin with Physics. The requirement of Physics on the part of the University has had the effect of directing the attention of the schools to a subject which they ought to teach in their own interest. Indeed, so popular has the study become that it would no doubt continue to be generally taught even if it were no longer required.

In addition to these two ways of gaining flexibility, the substitution of alternative entrance subjects for alternative groups and the reduction of the number of required subjects, a third method remains to be mentioned. The new entrance requirements take a modest step in the direction of the recognition of new subjects. Zoology takes its place by the side of Botany as an entrance elective. Students who present neither Botany nor Zoology may, if they desire, present a year's work made up in part of Botany and in part of Zoology. Physiography has also been placed on the list of subjects which may be counted for admission. The work that must be done in these subjects, if they are to be counted for entrance, is described in a leaflet published by the University. The question is sometimes asked whether the work in Physiology now done by the schools may be presented instead of Botany. To the question in this form the answer must be in the negative. It is, however, another question whether a course could be mapped out that should include the Physiology and Hygiene which the schools are compelled

to teach and which should at the same time be so scientific in character as to entitle it to recognition as an entrance elective. Perhaps a solution of the problem may yet be found. Those among us whose opinion is most worthy of attention think the thing is not feasible. Harvard, however, in its new requirements recognizes a year's work in what it calls Anatomy, Physiology and Hygiene.

In making the changes that have been described, it was not the intention of the Faculty to increase the requirements for admission. Inasmuch as Botany was made an elective, it was clearly necessary to increase the requirement in that subject from a semester to a year in order that it might have equal value with the subjects with which it was made interchangeable. The time assigned to Mathematics, three units of four periods a week, is slightly less than the time now generally given to the subject, five periods a week for two and a half years. It was not easy to decide how many units to assign to English. In fixing the number at three, the Faculty was guided by the consideration that the stronger schools were already giving to the subject an amount of time equal to two years and a half at five periods a week, or three years at four periods a week, and that if any change was incidentally made it should be in the direction of increasing rather than of decreasing the English requirement. In defining a unit as a subject pursued for four periods a week throughout a school year, the Faculty merely sought to indicate the amount of time that must be given to a subject if it is to be counted for admission. There was, of course, no thought of bringing a pressure to bear on the schools to induce them to adopt the four period system, but rather a recognition by the University of a tendency in that direction on the part of the schools. The three units of English required may be spread over four years of three periods a week, just as the requirement of three units in Mathematics may be met in two years and a half if five periods a week are given to the subject. The definition of a unit as four periods a week more than counterbalances any increase in the requirements in Botany and English. The amount of work required in Latin is, for example, reduced as a result of this definition by three books of Virgil.

Attention may be called in this connection to a peculiar feature of the requirement in English. It is indeed a requirement both in Composition and in Literature, as the description of the work required plainly shows. These two subjects ought to be studied in parallel lines from the beginning to the end of the course. If this is done, however, where is the line to be drawn between the three units of English required from all students and the year's work in English literature that may be offered as an entrance elective. It is clearly unsatisfactory to say that the study of a brief sketch of the history of English Literature constitutes the difference, for such a study may form part of the three units. Or is the question whether the credit is to be three or four units to depend on the amount of time given to the sub-

ject? To make credit depend mainly on time is far from an ideal arrangement. Some answer must be found to this question if candidates for admission are to be allowed to count English Literature as an elective unit over and above the three units of English that all students are required to present.

The conservative character of the changes described in this paper may best be brought out by calling attention to the fact that with the sole exception of the increased requirement in Botany, and possibly in English, the old groups fit into the new system. They are but a few out of the large number of combinations that are now possible. The decisive fact is that the schools, in preparing students for the University, are no longer limited to these particular combinations, but may freely choose from a fairly large list of subjects, provided only they meet a few fundamental requirements. The group system was a standing temptation to the schools to scatter their energies by preparing for as many courses or groups as possible. There is no reason why every school should teach all the entrance subjects or why every school program should be the duplicate of every other. Individuality is as much to be desired in schools as in persons. Local conditions and the qualifications of the teaching force ought to be important factors in shaping the school program. Concentration upon a relatively small number of subjects explains as much as any other one thing the strength of the A.B. course. The chief defect of the old B.L. preparation was the fact that it was made up of a large number of subjects pursued for the most part for but one semester. Much has already been done to remedy this evil, and no doubt the improvement will be still more rapid now that the schools have greater freedom to choose their own line of development and are under less temptation to multiply courses. As the schools grow the number of subjects which are studied for a period of two or more years will no doubt increase. As advanced work comes to be done in new lines, it will find a place among entrance electives. How far the work of the schools shall be elementary and how far advanced is, however, a problem which the schools themselves must work out. The high rank of the Michigan schools is no doubt due to no inconsiderable extent to the stimulating guidance of the University. But the University, in its relation to the schools, has never lost sight of the fact that they have a life of their own, which it may indeed foster but may not mar.

THE EQUIPMENT OF THE HIGH SCHOOL PRINCIPAL.*

PRINCIPAL S. O. HARTWELL, KALAMAZOO.

The topic is one in which most of us are directly interested, and upon it all of us are likely to have definite views. The opportunities that it gives for cataloguing our virtues or dissecting our faults I shall hope to avoid, for the sake of limiting the discussion to a few points in the professional equipment of the high school principal which seem to me to have become essential.

A few years ago any consideration of this subject as distinct from the general fundamentals of equipment requisite for all secondary teachers would have seemed academic rather than practical. Few will so regard it now. The march of events has raised our public high schools to a position of greater importance than ever before. Their growth in the last ten years is too well known to need description. In the North Central states the enrollment in public secondary schools, in the year 1890–91, was a little over 104,000; in 1898–99 (the latest figures obtainable) it was as much over 242,000. In the same way the amount and character of the work done has been strengthened in the last decade. The change in the last thirty years has well nigh amounted to a revolution. And the trend of progress seems to denote a farther advance. The changes incident to this growth and improved organization have naturally brought to the principal increased labor, but they have enlarged his opportunity and his responsibility as well. The difference in degree is becoming a difference in kind until to the native ability supposed to be found hitherto in public servants of this class there is now added a demand for professional training but lately unheard of. The post has become a professional one, and the principals themselves should be the first to recognize the fact. To do so is not to magnify one's office—rather failure to do so means the acceptance of too low a standard.

The daily problems of the principal of a large school are, to some degree, comparable to those of the executives of the higher institutions; the difficulties in a small school are sometimes even more acute. In the high school the question of the adjustment of work to the pupil, of the pupil to his work, and of different departments to each other, bring problems as perplexing and varied as those found at any stage of the pupil's advancement. These have lately increased by the broadening of courses and the extension of the elective system. To meet them successfully a man must either have great ability, or a training that shall equip average ability and judgment to do efficiently a highly organized work. Brains are fairly plentiful, but talent is not sown broadcast. Brains, then, developed by good

*Read at the meeting [illegible]

training, must always be looked to meet the requirements of this profession, as of all others.

This fact is not new or striking, but its immediate application seems not fully perceived except in the pedagogical departments of our universities. If it has reached the other departments it hardly influences their action. Hence it is generally appreciated by candidates looking forward to this line of work, and, quite naturally, by school boards in search of candidates—if they ever have to search for the omnipresent.

Under our present organization the principal is a specialist. But if I may start with a contradiction, that is just what he may not be, at least as the term is commonly used. The specializing that will best prepare him for work will include a training of executive power and of judicious sympathy; a study of at least two divisions of the educational field, the one in which he is to toil and the one just below; and as well the broadest possible scholarship Captain John Bigelow, in his interesting book on the Santiago campaign, advocates a general staff which shall oversee and regulate the various war bureaus. This, he claims, is necessary if war scandals, such as lately disturbed and wearied us, are to be avoided in future; and he describes the men required as "specialists in specialties." The phrase may be transferred to the description of the high school principal. The training that will secure this kind of equipment comes very near the old idea of general culture.

For many moons scholars have been arrayed under the two banners, classical and scientific. The field of knowledge has other divisions, but, from the nature or method of their work, most intellectual workers have been content to be placed in one of these classes. It is not necessary to recall the antagonism between them that has sometimes made them appear as hostile camps rather than co-workers for righteousness. In the places where we ought to hope for broad sympathy with intellectual advancement, whatever the path, there has too often been unseemly quarreling over leadership and relative value. The effect on the school has been bad, through false training of their managers-to-be. Too many college departments have been interested in securing (i. e., in training) partisans rather than intellectual patriots. Having found a youth with interest and preference for their chosen line, they have tried to foster those qualities by the process of exclusion. Then they have been active, sometimes officious, in getting for this product a position to teach—which is all right; or quite as likely, a place as principal or superintendent, where he is expected not only to teach but to arrange his dominion, large or small, around the pivotal Latin or the pivotal science, as the case may be—which is all wrong. I do not think this tendency so marked now as it has been; nevertheless, it is still too prevalent and influential. Its bad policy, from the college view-point, might be shown. Its effects on the schools are injustice and deformity.

Such training may do (would it were more often supplemented) for the special teacher; it will not suffice for those who hope, as principals, to influence school policies or to direct the activity of a hundred or hundreds of children of many minds, different temperaments, and widely varied conditions of life. In the sense described, the high school principal cannot afford to be, has no right to be, a specialist. He needs the broadest intellectual equipment he can secure, coupled with a working knowledge of scientific methods. I would not be misunderstood as in any sense undervaluing scholarship or even special proficiency in one field. A specialty—retaining the word's general usage—need not be in the principal's way. He may if he is strong enough make it his most useful ally. But to meet his full opportunity he must be able to make it a point of departure rather than his centre of energy, to use the precision and method gained from it for attacking other fields, until he shall at least have surveyed their outlines and secured a point of view. Classical students, scientific students, students of history and literature ought to make equally good principals, if of similar ability. But they must break away from traditional theories as to relative values, and so broaden their intellectual sympathy as to be able to appreciate the worth of all honest intellectual effort. If I mistake not, it is toward this end that the best departments of pedagogy are now directing their training. But too often they seem to be striving single-handed against the current of influence in other departments. Practically the case reduces itself to this; he who is now preparing for the broader lines of teaching should look to the pedagogical department for inspiration and direction of work, to the others for all he can absorb during the years of his course.

There are, naturally, practical considerations that limit somewhat the relative value of the different lines of preparation. It is still usual for a principal to remain in charge of one department in addition to his general charge of the school. When this is so the conditions seem to me to put the heaviest handicap upon the scientist. Experimental work and preparations for it are heavy consumers of extra time. Regarding the inherent possibilities of producing power, I believe, too, that the student of history and literature—whether the latter is ancient or modern, English or Greek—has the greatest advantage. These studies deal most directly with human nature as exhibited individually or in the mass. But that is beside the question. To make the first essential in the choice of a principal the fact that he is a classicist or a scientist is folly. Yet many boards still do this and are encouraged to do it. The prime requisite is scholarship vital enough to continue its growth; a scholarship that will not degenerate, that has not degenerated, into scholasticism.

Political conditions in Asia and Africa have developed in the last few years certain nebulous governments called buffer states. Through these

the European powers have tried to protect, by separation, their stronger spheres of influence. The principal's position as a harmonizer of different departments reminds one of these artificial political creations. But if schools lose equilibrium the immediate disaster to students is greater than when colleges become lop-sided. Hence the principal must be actively a director as well as a buffer, and hence, again, we come to the necessity of broad preparation and a wide outlook.

The mass of executive work in our schools is growing yearly. Few outsiders realize its amount, though every one admits the need of strong executive ability in the principal. Practically, I think, more can and should be done for training this power than has been hitherto. Some may object that executive ability comes by the grace of God—one has it or has it not, and training is superfluous. The same thing might be said of scholarship, but would hardly be accepted as an argument.

The need for a thorough study of education is just as clear. The opportunities to secure it are ample. One point only has to be emphasized. One who wishes now to do good work in a high school must give careful study to the grammar school department. I venture to say that lack of accurate knowledge of the conditions and character of the work of the grammar grades is the greatest fault of the present generation of high school principals. The failure to co-ordinate the departments is shown by the proverbial gap between the grades and the high school, that chasm of discouragement and failure which swallows so many pupils. This fault does not lie wholly with the grades, any more than the former hiatus between school and college lay altogether upon the high school. For some years the high school and its problems have received the earnest attention of educational leaders, and particularly of college authorities. Those who have known most of our conditions have done us the most good. The far-away, censorious criticism of those who have not taken pains to observe has been alike futile and irritating It is but repeating a commonplace to say that the present field for fruitful labor is in the grammar grades. The bridging of the gap just mentioned rests as much with the high school as with those below. The principal's responsibility is established. The measure of success in his own department is likely soon to depend closely on his intelligent helpfulness in solving these grade problems. At present he is too apt to dismiss them as unimportant or beyond his sphere.

I have mentioned among the requisites of a principal a trained sympathy—trained sympathy because training gives control, and of all things he should avoid the unbalanced kind that ends in gush. In Elbert Hubard's essay on Joseph Addison he gives the characteristics of a gentleman as sympathy, knowledge and poise. "Poise," he goes on, "is the strength of body and the strength of mind to control your Sympathy and your Knowledge. Unless you control your emotions they run over and you stand

in the slop." This sloppy kind too often stands in mind for all sympathy. It is certainly one of our great modern nuisances, and the average man of education needs no warning to shun it. The danger for those of our calling lies most often in the other direction. While it affects all teachers, its influence on the principal may be most harmful. Executive detail, steadfast application to intellectual work beget interest in work or in a given subject for its own sake. They tend to exclude the living interest essential to success and preventive of fossilizing. The living and lively factors of our daily problem come to be simply factors. The specialist may forget that pupils, not studies, are to be taught; if the principal also disregards that fact the effect on the school is soon deadening.

The largest training of this power must come through experience. But experience, carelessly left to its own course, brings so many temptations to repress sympathy, so much devitalizing detail, that it seems to me the principal ought at the outset to put before himself the absolute necessity of retaining an interest in his pupils as reasonable human beings, and constantly correct his steps thereby. It is doubly hard from the fact that one must deal with immature minds, whose potential is easily obscured by present crudeness. But he who loses this sympathy has entered on the first stages of that creeping paralysis that benumbs so many "old stagers." Sympathy is not all. Most emphatically the gospel of work is to be the salvation of our schools. But rightly interpreted that gospel lies in rousing the individual to stronger effort by fitting work to immediate conditions. This can never be done unless quick, though well-poised, sympathy is added by those in charge to the careful study of conditions.

There is room in the principal's profession for the highest genius and virtue. Just as elsewhere, that room is oftenest unoccupied. But there is and always has been a supreme test of fitness—sincerity of character and purpose. Given that (and there is no cause to be ashamed of the way it has been met), it seems to me that any man may compel success if he fairly views and tries to meet the professional requirements. These, I have aimed to show, demand culture, which Charles Dudley Warner has called, "That fine product of scholarship and opportunity to which learning bears the same relation that mere manners do to the gentleman." They include trained administrative power, trained sympathy. As the field grows and the demands of the principal's position increase, even genius and virtue will halt wearily unless strengthened by such equipment. With it the average man is ready to meet the daily broadening opportunity.

THE REPORT OF THE COMMITTEE OF TWELVE ON COLLEGE ENTRANCE REQUIREMENTS IN GREEK.*

PRINCIPAL J. H. HARRIS, BAY CITY, MICHIGAN.

In the discussion of a report like the one indicated in the title, prepared with such laborious care and in such a thoroughly scientific spirit, it is hazardous and possibly presumptuous to indulge in criticism or question. The character and ability of the men who constituted the committee—sufficient in itself to lift it above the plane of petty and amateurish criticism; the unstinted toil expended in gathering, arranging and interpreting the material accumulated in the process of preparing the report; the endless pains taken in correcting, revising and testing every assertion formulated and every conclusion reached,—all combine to give the report a dignity, a significance and a value which has attended no secondary report since the report of the Committee of Ten. And it may be seriously questioned whether an exception may be made of that.

Commendation, therefore, is almost the only recourse left to one seeking to discuss the report or aiming to give something more than a resumé of the material contained in it. And to be reduced to the barren and profitless task of summarizing what some one else has said is neither complimentary to one's critical faculties, instructive to one's readers nor auspicious for the future of the cause. Finality in anything is to be deplored—most of all in education.

And so, while admitting the very great value of the report and while voicing the most thorough-going appreciation of its almost unvarying merit, it would be cause for regret if all its conclusions were so universally accepted and so irrefutably established that there was nothing more to be said. For myself I do not care to be lulled to dreamless and eternal sleep —like the Lotophagi--"no more to think or work or do," even though it be at the hands of the Committee of Fifteen or the Committee of Twelve.

It is not my purpose in this article to discuss the report of the Auxiliary Committee on Latin Courses in the secondary schools; that report has been already discussed by others. The report of the Auxiliary Committee on Greek has not, however, been accorded the special consideration which its importance deserves; and that, too, though it is the most vulnerable of the two reports.

The preparation of the Greek program presented to the committee a comparatively simple problem, first, because the amount of Greek literature suitable to preparatory work is limited and, second, because the problem had been much simplified by the discussions and report of the Greek Con-

* Read at the meeting in November, [illegible]

ference of the Committee of Ten, by the Commission of the New England colleges and by the Greek conference held at Columbia in the spring of 1896. The committee was unanimous in reaffirming the position taken by the Committe of Ten, and proposed a program which is in essential agreement with that of the Commission of New England Colleges and the Columbia Conference of 1896.

The committee makes six recommendations: First, as to Time: that three years be devoted to study of Greek in preparatory schools; second, as to Grammar: that a thorough and methodical study of Greek grammar go on *pari passu* with the reading of literature, so that the pupil may be thoroughly grounded in forms and syntax and that he be made so familiar with the order of presentation of the various topics in the grammar that he may be easily able to find the information for which he must be constantly seeking.

The third recommendation has reference to the instruction in Greek Composition, and urges that it be carried on from the beginning, with special attention in the third year. For this the familiar and conceded reasons are given: that it fixes the pupil's vocabulary, that it serves as a constant review of the Greek forms, that it quickens his sensitiveness to the peculiar significance of the order of words in the Greek prose sentence and to the fine distinctions of meaning between similar words and constructions, that it serves as a check to carelessness and that it tends to accurate scholarship. The reason why the committee lays special stress on the study of prose composition during the third year, when Homer is read, is that the pupil may preserve that familiarity with Attic forms and constructions which is essential to satisfactory work in college. The committee strongly recommends the method known as retroversion, that is, the re-turning into Greek of the English translation of some Attic prose which has been read by the student. The systematic presentation of Greek constructions in text-books prepared with no reference to a special text is also insisted on. The committee regards a combination of the two methods as desirable—a position which the writer of this article advocated in the *School Review* in the issue of June, 1894.

In the third recommendation, the committee advocates continued practice in sight reading, holding that it is not only desirable from the pupil's point of view in gaining a mastery of vocabulary and a confidence in his powers, but is of the utmost importance to the teacher in enabling him to detect the pupil's difficulties and weaknesses.

Reading Greek aloud is the next recommendation of the committee, and insistence is laid on securing the right quantity of the syllables.

Finally, as to what shall be read, the committee realizes that there is nothing more suitable and better adapted for second year reading than Xenophon's Anabasis, even though it may not be purest Attic. For the third

year the committee recommends that Homer be read, and while admitting that from one point of view the study of Attic prose ought to be continued through the entire preparatory course, yet, for the sake of those students who take Greek only in the preparatory school and do not intend to go to college, and as well also as an inspiration to those who are to continue their studies in college—giving them an enticing foretaste of what is ahead—the committte recommends that Homer be read through the entire third year.

In discussing this report—so complete, so suggestive, so scientifically developed—it seems to me there are only two points on which a difference of opinion can possibly exist. These are, first, the question of the amount of time to be devoted to Greek in the secondary school, and, second, the question of the reading of Homer. On all other points there can hardly be other than complete unanimity of opinion. With the committee recommendations regarding grammar, composition, reading aloud, sight-reading and reading material, all teachers of Greek would be in hearty accord. They set forth clearly and conclusively the essential characteristics of the preparatory instruction in Greek. Providing also a three years' course is predicated, I believe the recommendation of the committee as to the reading of Homer is based on sound and convincing grounds and would meet with no serious dissent. The reading of a portion of Homer is eminently desirable provided enough time can be given it to make it of real worth. If it is to be crowded in during the last six or eight weeks of a two years' course, then the advisability of reading it may well be called in question. The whole discussion, therefore, sifts down to the the one problem of Time: in other words, to the recommendation of the committtee that three years' time be devoted to the study of Greek in the secondary school. In discussing the point I shall aim to look at it largely as a practical problem in school administration from a secondary point of view. I realize full well, how, from the University point of view, three years' preparation in Greek is eminently desirable and urgently advocated. It is to the interest of the college and university that its matriculates come up with as large and advanced a preparation as possible. From the point of view, too, of the specialist in Greek, the requirement of three years may logically be urged. To him Greek is the *sine qua non* of a finished education, and the more of it that can be had the better.

But besides the view-points of the college and the Greek professor, there must also be taken into consideration by those who have courses of study to construct, the large and constantly increasing number of interests which a secondary school has to conserve. A public high school particularly must have due regard not alone to those claims and demands which spring from above, but as well to those who support it and who demand its privileges for every legitimate and properly accredited branch of instruction. In saying this I do not mean to intimate thereby that the public in general

is hostile to Greek. I do not think it is, only I think it feels that Greek should not exact more than its fair share of the time and effort of the school, to the prejudice of other studies that may have equal value for life. And with the present multiplicity of studies and with the present insistence which each department of thought and scholarship is placing upon the worth and importance of its specialty, the only possible course for the administrator of school programs is that of the conservative and judicial arbiter who serves as a mediator between the people clamoring on the one hand for the practical and utilitarian and the university specialist on the other calling for an ever increasing share of time for his particular interest. Years ago when the range of secondary studies was comparatively limited, when Latin and Greek constituted not only the backbone but the very body and substance of the course; when the sciences received only the minutest fraction of the time or attention now devoted to them; when English, as a branch of instruction, was only a child in swaddling clothes compared to its present stage of growth and development; when history had not attained nor even aspired to that dignity and importance which its merits deserved and its value justified; when even mathematics, that staid and substantial child ot the ages, was content with a more modest portion of the educational menu; *then*, I say, it was not so difficult nor so impracticable to give Greek the three years' time which its friends felt that it deserved. But the question of how much time is to be devoted to Greek in the secondary school is not solely nor even primarily an academic question, to be solved only in the study of the Greek enthusiast. It is a very practical and every-day question of time, teachers, expense and a due regard for all the interests which go to make up a thoroughly modern school. Nor is it a question of the educational value of Greek. Admitting all that may be said in behalf of Greek as an instrument of discipline and culture—and as a teacher of Greek I should be the last to call these in question it still would be true that one might fairly raise the query whether, under existing conditions, the recommendation of three years' preparatory Greek is not an error in judgment, and whether it would not have been much better for the cause of Greek if only two years had been called. The demand for three years can hardly fail to arouse objections and antagonisms. The demand for two years would have been met with friendliness and favor. With so many subjects pressing upon the pupil's time and attention, competing for his favor, it is hardly fair that more than two years of his preparatory school time be given to Greek. If he desires further acquaintance with it or discovers in himself linguistic capacities, the opportunity for further and more specialized study will be furnished by the university or college.

But the conditions of modern life are so complex that he who has developed one set of capacities at the expense of the other finds himself at a disadvantage. He is not prepared to meet life on all sides. The adjustments

necessary to the complete and intricate environment in which we find ourselves are so nice and precise, that it demands the most careful thought to attain the right end and the right results from our educating process. If the biological conception of the nature of education is the sound and accepted one, and if it is the function of education to enable us to react more effectively and accurately upon our environments, then the time-element in the claims of any particular study calls for the most rigid and searching investigation. And the specialist is in some respects the least competent to pass judgment upon it! Just what educational value a study has in the process of mental development; just what amount of time is necessary to give it its full value; just where to draw the line between the extravagant and exuberant claims of friends and the no less exaggerated and unreasoning antagonisms of enemies; these are nice questions of the law, and call, not for the partisan, but for the judge. Greek has its distinct and undeniable educational value. It is not necessary to enter upon an argument for its worth or to give expression to the reasons which justify its place in the secondary program. But whether the value and the function of Greek may not be equally subserved, nay, even more surely and permanently subserved, by putting forth the very modest and legitimate claim of two years of preparatory study, is a very interesting and possibly a very crucial question. For while the claims of Greek to two years' time might not be called in question nor antagonized, the claim of three years, by its dangerous proximity to selfishness, might lead to opposition and even a denial of its more moderate and wholly reasonable rights and privileges.

And so, from the point of view of a secondary school program, already gorged with a superabundance of studies; from the point of view of a classical curriculum wherein the requirements in Latin and Greek are becoming more and more extensive and exacting; from the point of view of a riper and more modern conception of education in which science, history and English are calling for a just recognition of their claims, and wherein modern political, social and religious conditions are recognized as so radically different from those of fifty years ago as to demand, a system of education essentially different both in form and content; from the point of view, finally, of the interest and future of Greek itself, I must venture to regret the action of the committee in restricting itself solely to a course of study covering three years. The least that it could have done would have been to outline a course covering three years, as did the Latin committee in the six-year and the four-year courses. For it certainly is true that a very large number of schools can give only two years to Greek, and for their benefit and guidance a two years' course should have been laid down. It is a little difficult to appreciate the reasons which prevented the committee from preparing such a course, but inasmuch as it was not done, the work of the committee can hardly be looked on as other than incomplete.

PHYSICS CONFERENCE.

March 30, 1900.

ELECTRICAL MEASUREMENTS IN THE HIGH SCHOOL LABORATORY.

BY C. F. ADAMS, DETROIT, MICH.

It is embarrassing to attempt to treat such a broad subject as this in the few minutes at my disposal. I can only attempt in a very general way to state what quantitative exercises in electricity seem to me best adapted to the high school and to indicate the apparatus best suited for such exercises. I do not wish to be understood as saying that those I recommend are the only exercises in electricity and magnetism to be attempted, but they seem to me about the only ones in electrical measurenmts well adapted to the high school. The list I would recommend is as follows:

(1) The Determination of the Constant of a Tangent Galvanometer by a Gas Voltameter.

(2) Measurement of Electromotive Force of Cells (single cells and cells joined in parallel and in series).

(3) Ohm's Law:—Fall of Potential Along a Conductor.

(4) Resistance of Wires by Wheatstone Bridge,—verification of law of length, law of diameter, and law of shunt circuits.

(5) Resistance of Cells, only non-polarizing cells, such as the Daniell or gravity, being used.

Equipment:

1. A tangent galvanometer.
2. A telescope and scale.
3. A bracket to support telescope and scale.
4. Two Leclanche cells.
5. Four Daniell cells.
6. A D'Arsonval galvanometer.
7. A commutator.
8. A resistance box.
9. A 5000 ohm coil.
10. A Wheatstone sliding bridge.
11. A burette.
12. Two platinum electrodes.

13.—Sundry supplies as follows: Several spools of copper wire of known length and diameter, ¼ oz. No. 40 copper wire, ½ lb. bare German silver wire No. 24, a soldering outfit, ability to use a few tools, and, lastly, abundance of perseverance and patience.

Such an equipment as this will provide for a large amount of substantial laboratory work and will cost about $25, though a considerable part of this sum can be saved by the teacher if he has some mechanical ability or if he can enlist that of his pupils in his service.

I have placed in the list a tangent galvanometer which for general electrical measurements is considered by many to be out of date. My own experience leads me to prefer the D'Arsonval, with telescope and scale, for nearly all of my work. However, I have found no exercise in electricity more instructive and interesting to the pupil than that of finding the constant of a tangent galvanometer by means of a voltameter. I recommend this exercise for its own excellence. It is not necessary for one to spend very much money for a tangent galvanometer. Almost any physics class will furnish one or more boys capable of making a fair instrument, and one that may be used for the other exercises if found necessary or desirable. A burette placed over the negative electrode makes an excellent voltameter, and the resistance of the circuit can be controlled by raising or lowering the burette about the electrode.

The D'Arsonval galvanometer, when a resistance of 5,000 ohms or more is joined in series with it, practically becomes a voltmeter, and with the telescope and scale arrangement the deflections are proportional to the current or to the electromotive force. Hence by comparing deflections, the electromotive forces of cells and batteries can be compared and the fall of potential along a conductor can be determined. One or two ounces of No. 36 German silver wire will make a high resistance coil to be used with the galvanometer.

The D'Arsonval galvanometer should be placed on a bracket on the wall near the window, or on the window sill itself. In the latter case a screen must be placed back of the instrument to shut out the direct light from the telescope. The telescope and scale should be supported on a bracket about 30 inches long. Any blacksmith can make an excellent bracket for this purpose out of wrought iron. If the building be of brick, the galvanometer so placed will generally be free from vibration due to walking about the laboratory or jarring of tables. Telescopes that can be bought at prices ranging from 99 cents to $2.50 can by slight modifications be made into quite good reading telescopes.

The ordinary cheap resistance boxes commonly sold to high schools are far from satisfactory. For my part I do not appreciate the fractional ohm coils placed in them. I should think manufacturers might substitute for them about three 2,000 ohm coils at no additional expense, since these need

not be adjusted at all accurately to any fixed value. Plug resistance boxes costing only a dollar or two more than the common form are now in the market, and are much to be preferred. To be sure they are not very accurate, but the several coils do not constantly vary in value whenever a new adjustment is made. I would suggest that some teachers might make it a part of their summer school work at the University to adjust and correct such a resistance box. Possibly the department of physics might find it feasible to have students test and perhaps adjust resistance boxes for such high schools as choose to send them to the University.

The other items of the equipment need little comment. I might say that the No. 40 wire is intended to supply suspensions for the coil of the D'Arsonval galvanometer. Time does not permit me to go further into detail in regard to the several exercises, and it would not be very profitable for us without the apparatus itself before us to make what I might say interesting and clear.

QUANTITATIVE WORK WITH THE INCLINED PLANE.

BY C. S. COOKE, DETROIT, MICH.

Not being satisfied with the discussion of the inclined plane as it was left at our last physical conference, I determined to submit some data taken by our pupils recently to show that it is possible to get results considerably within one per cent of error as against the two or three per cent. set as the limit last year. It is my purpose also to speak of certain difficulties we have encountered in this experiment, and to tell how we think we have overcome them.

First, I wish briefly to outline the experiment as it is performed in our laboratory. The apparatus consists of a smooth board four or five feet long by eight inches wide, arranged with one end elevated above the table and slightly projecting, so that a scale-pan attached by a stout cord to a four-wheeled car may rise and fall freely by the end of the table while the car rolls up and down the plane. The cord of course passes over a pulley clamped to the end of the board, which is so arranged that the cord will be parallel to the plane of the board. The weight of the scale pan is taken, and that of the car, together with its load. Then the vertical rise of the plane per 75 cm. of its length is measured. To accomplish this, a meter stick with a straight edge is placed on the plane and slid down until its end just touches the table, when 75 cm mark is noted. The vertical rise needs to be measured with considerable care. Half a meter-stick mounted on a suitable base [illegible] useful for this. The pupil then finds by trial what weight in the pan is necessary to pull the car up the plane with uniform speed after it is

started. In a similar way the weight in the pan that will allow the car to roll down the plane is determined. In each case the average of several determinations is taken. Assuming that the friction is constant, it can be eliminated by taking one-half the sum of the weight in the pan, together with the weight of the pan. This would be the force necessary to balance the car and its load, if there were no friction. If the ratio of the length of the plane to its height equals, within reasonable limit of error, the ratio of the weight to the effort, the pupil can say that he has verified the law of the inclined plane.

When we first began to perform the experiment, the cars gave considerable trouble. Adjustable cars that give entire satisfaction are now common. Our greatest difficulty has been in securing suitable planes. All that we have had any experience with have twisted out of shape. We have tried different kinds of wood, but always with the same result. Such has been our experience the past three or four years. Last fall strips of plate glass were obtained and placed on the planes, and now all our difficulties along that line have vanished. The delicacy is also very much improved, for two or three grams either way from the correct weight in the pan are enough to make the car depart from uniform motion. Despite the improved plane, our results were not what they should be. It was suggested that perhaps the tables were not level. A carpenter's spirit level was obtained, the tables readjusted, and now everything works well. The following data will show the effect of working on an uneven table:

Weight of pan	70.5 grams.
Weight of car and its load	1405 grams.
Vertical rise of plane per 75 cm. of length..........	32.4 cm.
Pan, plus weights, car going up....................	645.5 grams.
Pan, plus weights, car going down..................	558.5 grams.
One-half the sum	602 grams.

$$\frac{L}{H} = \frac{75}{32.4} = 2.315$$

$$\frac{W}{P} = \frac{1405}{602} = 2.333$$

These ratios show a variation of approximately 18 parts in 2,000, or .9 of one per cent. When the level was placed on the table, it showed that the vertical rise was too great by .3 cm., or 32.1 cm. for the correct vertical height; 75 divided by 32.1 gives 2.336, a variation of a little over .1 of one per cent.

Let us inspect the results exhibited in the table on the following page and see what conclusions may be drawn.

I wish to call attention to the fact that these are not selected results, but the actual work of all the pupils. The different groups represent the work done by different pupils on the same piece of apparatus. In only one case is the variation greater than one per cent. In this instance it is apparent

that the pupil has made a mistake in counting the weights. I found the average error of the class to be one-third of one per cent.

Notice that the weight in the pan does not vary greatly.

It may be interesting to notice which factor is the most liable to error. I think it will be granted that it lies between the measurement of "P" and "H." Take, for instance, the results at table No. 6, in which the vertical rise is 33.3 cm. in one case and 33.4 cm. in another. Comparing 2.252 with 2.246, we see there is a difference of .006. Take the third and fourth results, in which "H" remains the same and in which "P" varies by 5 grams. Here we have a difference of .013. This means that an error of 1 mm. in the vertical rise is equivalent to a mistake of between two and three grams in the pan. All things being considered, it is a great deal easier to make a mistake of 1 mm. in measuring the vertical rise than it is to make an equivalent error of two or three grams in the scale-pan.

Table.	Weight of Car and Load. (W.)	Vertical rise of Plane per 75 cm. of length. (H)	One-half sum of weights in pan. (P.)	L/H	W/P	Table.	Weight of Car and Load. (W.)	Vertical rise of Plane per 75 cm. of length. (H)	One-half sum of weight in pan. (P.)	L/H	W/P
	1461	34.0	665.1	2.205	2.197		1889	33.3	838.8	2.352	2.252
	1456	34.0	665.4	2.205	2.188		1890	33.35	842.7	2.248	2.244
1	1457	34.0	663.4	2.205	2.196	6	1888	33.35	838.2	2.248	2.252
	1462	33.95	665.4	2.208	2.197		1888	33.35	833.2	2.248	2.265
	[illegible]	33.9	662.7	2.212	2.201		1888	33.4	838.1	2.246	2.252
	1403	32.2	602.8	2.329	2.327		1905	32.9	837.5	2.279	2.275
	1402	32.2	603.3	2.329	2.324		1907	32.75	835.5	2.290	2.283
2	[illegible]	32.2	600.8	2.329	2.333	7	1905	33.0	836.0	2.272	2.278
	[illegible]	32.2	605.4	2.320	2.319						
	1907	32.7	835.7	2.293	2.822		2104	32.45	952.4	2.311	2.304
	1911	32.8	838.3	2.286	2.279		2106	32.45	961.0	2.311	2.284
3	1913	32.8	835.5	2.286	2.289	8	2104	32.4	946.9	2.314	2.316
	[illegible]	32.75	837.[illegible]	2.290	2.281		2104	32.5	947.3	2.307	2.315
	[illegible]	32.8	834.8	2.286	2.293		2105	32.45	941.8	2.311	2.331
	[illegible]	[illegible]	75[illegible]	2.430	2.440		2200	32.2	941.0	2.329	2.337
	[illegible]	[illegible]	757.[illegible]	2.450	2.430		2105	32.15	938.2	2.332	2.339
4	[illegible]	[illegible]	75[illegible]	2.443	2.436	9	2107	32.2	983.1	2.329	2.341
	[illegible]	[illegible]	755.2	2.443	2.444		2107	32.2	940.3	2.329	2.336
							2201	32.2	930.3	2.329	2.343
	[illegible]	30.05	740.6	2.495	2.498		1845	32.0	808.1	2.300	2.283
	1857	30.05	741.3	2.495	2.505						
5	1851	30.05	741.4	2.495	2.496	10					
	[illegible]	[illegible]	741.1	2.500	[illegible]						
	[illegible]	30.05	741.8	2.495	2.494						

AN IMPROVED METHOD FOR TIMING A PENDULUM.

BY W. H. HAWKES, ANN ARBOR, MICH.

The method of coincidence is undoubtedly the most acceptable method for the determination of time of recurrence of like phases of a body vibrating in regularly recurring periods. This method as applied to the pendulum consists in noting by some means the instant the pendulum of unknown time is in coincidence with one of known time, as the seconds pendulum, and observing the number of vibrations of both pendulums before the two are in

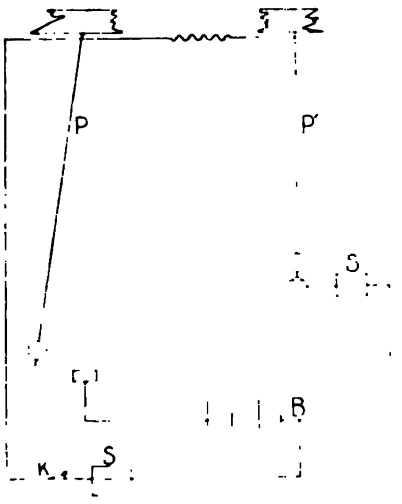


Fig. 1.

the same phase again. The means by which this coincidence has heretofore been obtained, especially in the hands of untrained and unskilled pupils, has in it a source of error because of the uncertainty which always exists where an attempt is made to locate accurately by the eye the exact position of a moving body at a particular instant of time, even where the error is much reduced by the use of the telescope to cut down the field of vision. If, however, the particular swing of the unknown pendulum which is in coincidence with the seconds pendulum is in some way distinguished, the chief difficulty is overcome.

This is accomplished in the following manner:

The two pendulums, known and unknown, are connected (as shown in Fig. 1*) in the same battery circuit with a sounder or marker of some

* Owing to a slight inaccuracy in the engraving the horizontal wire appears to be connected with the pendulums below, instead of at, the points of their attachment to the support.

sort. Each pendulum is provided with a mercury contact so that the circuit will only be closed when both pendulums are in contact with the mercury at the same time, that is, of course, the time of the coincidence. Then the click of the sounder is heard, and only at that time.

This method easily shows the difference in the time of the swing of the pendulum through a small arc and through one two or three times as large, so that the method is applicable to all parts of the problem.

This method has been tried with great success in actual laboratory practice. Eight or ten pendulums may be connected with one clock or seconds pendulum, so that a large laboratory section may be accommodated without difficulty, the pendulum of each set of students being connected with the seconds pendulum.

B = Battery.
P = Seconds Pendulum.
P' = Experimental Pendulum.
S = Sounder for Coincidences.
S' = Sounder for Seconds.
B S' K P = Shunt circuit for ticking seconds.

APPARATUS FOR COEFFICIENT OF EXPANSION OF A SOLID.

BY L. M. PARROTT, SAGINAW, E. S., MICH.

The determination of the coefficient of linear expansion of a solid involves the measurement of a quantity so small that it must be determined with some form of micrometer screw or else be magnified by a system of levers. These two methods of measurement constitute the basis for the two general forms of apparatus in current use. This apparatus involves both ideas, but is essentially the lever type. A reference to Fig. 2, in which the frame work and central part are omitted, will make clear its essential features. AB is the rod under consideration, surrounded by the jacket KL. Steam is admitted at M and it escapes at N. P and R are sockets for the introduction of the thermometers *s* and *t*. A third socket and thermometer is placed midway between A and B. These sockets are not placed directly on top of the jacket, but at an angle to the vertical, as indicated in the end view. Socket R is directly behind socket P'. EV is a piece of plate glass, the function of which is to assure even connection at B. EF is a micrometer screw working through the solid part of the frame W. CD is a small telescope pivoted at the point O so that it may swing in a vertical plane; and rigidly fastened at right angles to its lower side is a tongue OX making

contact with one end of the rod. The frame of the part of the apparatus above described is securely fastened to a side wall. A distant scale completes the apparatus. It is fastened to the same wall in such a way that each division is retained in a horizontal plane, with the zero in the plane of the pivot of the telescope, the whole scale so arranged that its distance from the telescope may be varied.

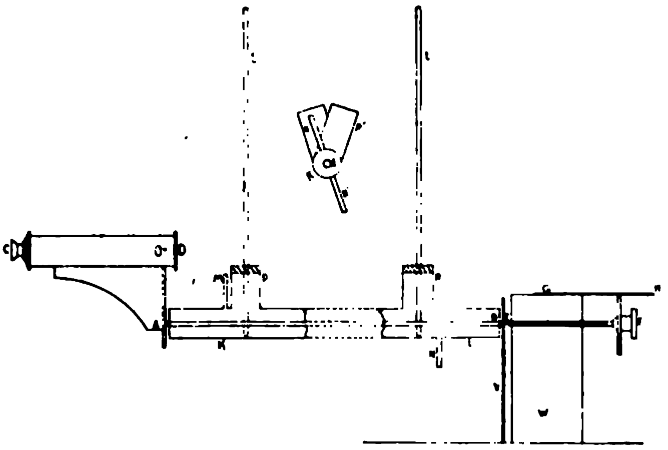


Fig. 2

After placing the rod with its jacket in position and siphoning cold water through to equalize the temperature, as is usual in all forms of apparatus for this experiment, the pupil is generally asked to measure the initial length of the rod. In this form it is unnecessary. The micrometer screw EF serves a double purpose. It is used primarily to adjust the position of AB so that the initial reading is zero, but it also serves a second purpose. When the reading is zero, the axis of the telescope, and hence the line

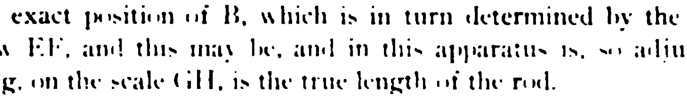


Fig. 3

of sight, is horizontal; the tongue OA is vertical and A is a definite point irrespective of the length of the rod AB. This length then depends entirely upon the exact position of B, which is in turn determined by the micrometer screw EF, and this may be, and in this apparatus is, so adjusted that its reading, on the scale GH, is the true length of the rod.

Referring now to Fig. 3, let AB represent the original length of the rod, AC the expansion per single degree rise of temperature, O the turn-

ing point and XY the distant scale. Then XOY is the angle through which the telescope is turned for the first degree rise of temperature. Let AB = m. AC = x, OA = r, OX = l. It is evident that the triangles XOY and COA are similar. Hence XY is proportional to the expansion x. But as m is a constant for each rod, XY is also proportional to $\frac{x}{m}$, which, by definition, is the coefficient of expansion, the constant of the ratio depending on the length l. By varying l then, we can make our apparatus directly read any number of times the coefficient of expansion rather than the expansion itself. If, for example, we wish to read one hundred thousand times the coefficient of expansion, then XY must be $\frac{100000x}{m}$, and from the triangles above we have $\frac{x}{r} = \frac{\frac{100000x}{m}}{l}$. Multiplying each member by $\frac{rl}{x}$ the unknown x is eliminated and we have $l = \frac{100000r}{m}$. But r is a constant value once measured always measured, and m is determined by the micrometer screw; l is then easily found, the scale XY is adjusted by means of a wall scale, and now our apparatus reads directly one hundred thousand times the coefficient of expansion. All that is then necessary is to divide the total reading by one hundred thousand times the number of degrees rise of temperature, and we have the coefficient of expansion of the rod.

A MODIFICATION OF THE GRAVESANDE APPARATUS.

BY N. B. SLOAN, BATTLE CREEK, MICH.

I think we will all agree that the principle of composition and resolution of forces is of such importance that any device which will bring the idea clearly and accurately before the student, is a welcome addition to our list of apparatus.

In presenting this piece to the conference I lay no particular claim to originality. The idea is identical with that of the Gravesande apparatus, as described in Deschanel's Natural Philosohpy, and the modifications are only such as secure ease in reading the results and a wider range to the use of the apparatus.

The apparatus (Fig. 1) consists of four wires, jointed to form the parallelogram [illegible], and a fifth wire ac forming the diagonal. At the corners b and d are attached cords, extending over the pulleys x and y. The pulleys are attached to the blocks P and Q, which are jointed to the frame. This is important, for with the addition of different weights in the scale pan E and the consequent rising or falling of the parallelogram to the new position of equilibrium, the pulleys will adjust themselves so that the tension due to the

weights *m* and *n* will always be in the straight line of the sides *ab* and *ad*. To the diagonal *ae* is attached a scale made, in this case, of a thin strip of sheet zinc so that the length of the diagonal is read directly in cm. R is a protractor (also made of zinc and soldered to the side *ab*) for reading the angle formed by the adjacent sides *ab* and *ad*. The side *ab* is 20 cm. long and *ad* is 10 cm.

The experiment may be given as follows: The apparatus is adjusted so that scale pans and parallelograms are in equilibrium. A weight of 200 grams is placed in the pan *m* and 100 g. in *n*. These are constant. A weight of

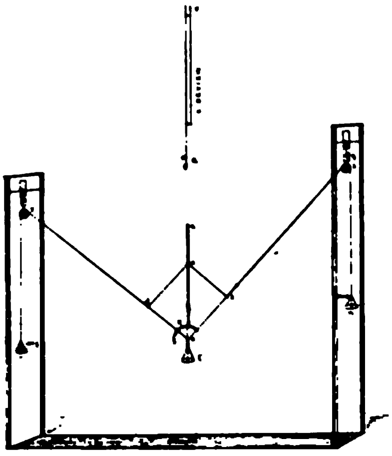


Fig. 1

200 g. is placed in E, *ab* and *ad* are measured and the ratio of these quantities is compared with that of the weights. Then *ae* and the angle *bad* are read off. Then take a series of readings with different weights in E and make a record of the same. Then place weights in E until the angle *bad* is one of 70°, then 80°, 90°, 100°, 110°, recording each time the angle, the weight in E and the length of *ae*. With the formula $R^2 = P^2 + Q^2 - 2PQ. \cos o$. compute R and find the difference between the computed R and R as observed on *ae*.

The following results are obtained by students:

Angle.	E.	R.	Computed R	Error.
70	250	25	25.23	.23
80	240	24	23.8[illegible]	.14
90	220	22.5	22.3[illegible]	.14
100	21[illegible]	21	2[illegible].7[illegible]	.2[illegible]
110	184	1[illegible]	1[illegible]	.[illegible]

THE CONSTANT VOLUME AIR THERMOMETER.

BY A. O. WILKINSON, DETROIT, MICH.

I claim nothing new in what I have to present. It is merely a method that I have made use of in the laboratory to show the constant relation between the temperature of a gas and its pressure. The apparatus (Fig. 5) consists of a glass flask containing dry air, made dry by a little sulphuric acid placed in the flask. This is inclosed in a tin can filled so as to cover the flask. Leading out of the flask is a glass tube bent twice at right angles,

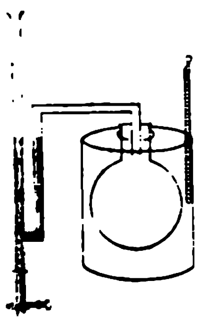


Fig. 5.

which is connected to another glass tube having a rubber tube and a pinch cock at the bottom. These tubes can be placed in front of a mirror scale. Mercury is placed in the longer arm; when the mercury is at the same height in both arms, the air, of course, is under the pressure indicated by the barometer; its temperature is that of the water.

To obtain other readings heat is applied to the can and enough mercury is poured into the longer tube to bring the mercury in the short arm to its original position, when the volume of the inclosed air is the same as the original volume. The difference in the heights of the mercury in the arms measures the increase of pressure. These results are tabulated as pressure and absolute temperature. The temperature is then divided by the pressure to show the constant relation, i. e., the temperature measured on the absolute scale varies directly as the pressure.

COEFFICIENT OF EXPANSION OF A GAS AT CONSTANT PRESSURE.

BY N. H. WILLIAMS, DETROIT, MICH.

Among the physical constants that have been made the subjects of laboratory experiments, none is more important than the coefficient of expansion of a gas. Its relation to the absolute zero and its immediate application in the volumetric work of the laboratory make it of peculiar interest and importance to both the physicist and the chemist. Elaborate experiments have made known to us the value of this constant with considerable accuracy, but a simple apparatus that will give reasonably accurate results in the hands of students has not till the present time been devised. Experiments for finding the pressure coefficient at constant volume, however, have been successful.

Nearly a dozen different pieces of apparatus have been used by the author of this article, but with little success. Mercury as a valve to enclose the air is unsatisfactory. The gas, if in contact with water, expands very irregularly, and even if corrections are made for aqueous tension, no concordant results are obtained. Methods involving only measurements by weighing have been tried; in these cases glycerine being used in contact with the gas, but still the presence of water vapor introduced a large error. Some active drying agent as a valve to enclose the air is indispensible, and sulphuric acid seems to be the only liquid available. Its vapor tension is insignificant. Its density is much less than that of mercury, and hence the pressure can be more accurately adjusted. One method in which sulphuric acid was used is of interest because it shows how important it is to exclude every trace of moisture. A long U tube an eighth of an inch in diameter was employed. A little sulphuric acid was put into it to separate the air in the two sides. Into one arm there was fitted a piston of paraffined wood. A little mercury over the piston made it perfectly air tight. As the gas expanded or contracted with changes of temperature, the piston was moved so as to keep the surfaces of the acid in the two arms at the same level. The measurements were made by putting the tube into a deep jar of hot water and observing the temperature of the water and the position of the piston after the adjustment for pressure had been made. The apparatus was then put into cold water and the piston pushed down as the gas contracted. The temperature was again observed and the length of the air column measured. These data are sufficient for calculating the coefficient of expansion. The results obtained in this way were good, but if the apparatus is put into cold water first, it will be cooled below the dew point, and traces of moisture will be deposited in-

side the tube above the piston. As the piston is afterward raised in the second part of the operation, sufficient moisture will slip by it to cause an error of ten per cent. in the result.

This difficulty is eliminated by the apparatus described below. A glass tube a little over a meter long is bent into the form shown in figure 6. The shorter arm is closed by a short glass rod fused into the end of the tube. Some sulphuric acid is put in and another tube of smaller size is put into the open end and pushed down into the acid. The displacement of the acid by this tube as it is pushed downward raises the surface. This method permits an adjustment of the level through about eight inches, thus it is always possible to bring the surfaces of the liquid in the two arms to the same level and produce atmospheric pressure upon the enclosed gas. A metal band CC is arranged to slide upon the tubes. It is fastened to a wire, R, so that it may be adjusted to mark the liquid surface. The apparatus is put into cold water in a deep cylinder of glass and the level of the liquid in the long arm is adjusted to that in the short arm by moving the inner tube T up or down. The metal band is then brought to this level and the temperature of the water noted. Next the apparatus is placed before the mirrored scale of a Jolly balance and the length of the air column accurately measured. The operation is then repeated with water at a temperature thirty or forty degrees higher.

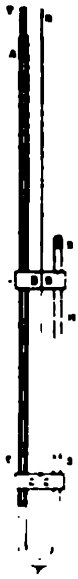


Fig. 6

If V_1 and V_2 represent the two volumes and t_1 and t_2 the corresponding temperatures, we shall have the two equations $V_1 = V_0(1+at_1)$ and $V_2 = V_0(1+at_2)$, in which V_0 is the volume of the gas at zero degrees C, and "a" the coefficient of expansion. Eliminating V_0 between these two equations and solving for "a" we have

$$a = \frac{V_1 - V_2}{V_2 t_1 - V_1 t_2}$$

The following results will give an idea of what may be expected of the apparatus. None of them show more than one per cent. of error. .00002 is added to each result as found by the formula to correct for the expansion of the glass: .00366, .00365, .00363, .00368, .00366, .00363, .00364, .00366, .00368, .00366, .00366.

The following results are obtained by one of the laboratory sections. The error in two cases is greater than one per cent. .00365, .00366, .00371, .00370, .00366, .00373, .00353, .00368.

A MODIFICATION OF HARE'S METHOD FOR DENSITIES OF LIQUIDS.

BY DE FORREST ROSS, YPSILANTI, MICH.

Fig. 7 represents an apparatus for determining the specific gravity of liquids by the Hare's method. It consists of a piece of board H about 100 cm. long by 15 cm. wide, rigidly fastened to a base K about 6 cm. wide, which, by being clamped to a table, supports the piece in a vertical position. 1, 2, 3, 4, 5 are test tubes 2 cm. in diameter by 10 cm. long, which contain the liquids to be tested; 3 contains water with which the other liquids are to be compared. R is a meter-stick for measuring the heights of the liquids in the various tubes by means of a carpenter's try-square.

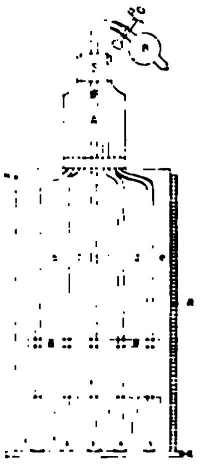


Fig. 7.

A is a bottle with the bottom cut off and fitted with a rubber stopper perforated to receive the tubes *a*, *b*, *c*, *d*, *e*. The top is closed with the rubber stopper S, perforated to receive the tube *s*, to which is attached the rubber bulb B, by means of which a part of the air in A is removed, thus causing the liquids to rise in the tubes. The pinch-cock O prevents the return of the air.

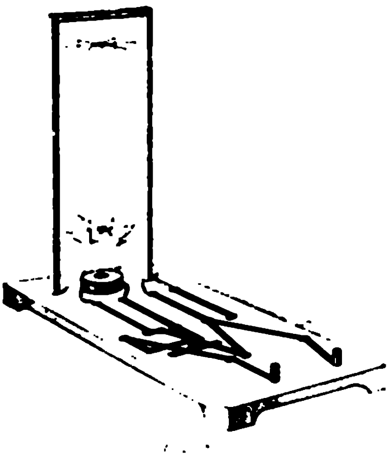
The advantages of this apparatus over that of two tubes connected by a "Y" tube are several. The thin glass test tubes permit of more accurate reading of the surfaces of the liquids. The same liquids are always in the same tubes. Several liquids may be compared at the same time with great accuracy, as the tongue of the try-square will come in contact with the tubes, thus avoiding the error of parallax and always being at right angles to the

tubes. The hand-pressure on the bulb B is a much more agreeable way, to say the least, than the mouth for removing the air from the tubes. The piece is cheap, easily made and always ready.

A MODIFIED AMPÈRE APPARATUS.

BY H. N. CHUTE, ANN ARBOR, MICH.

Supported on a stout steel wire, within a vertical rectangular helix of wire, is a series of three electrically independent rectangular helices rigidly fastened so as to turn together (Fig. 8) with their naked ends dipping into a circular trough of mercury divided into two opposite sectors of about 60° arc electrically connected to the binding posts on the base. By means of a



sliding commutator the direction of the current in these movable helices can be reversed, and by means of a switch the stationary rectangular helix can be placed in or out of circuit at pleasure. The revolving helices consist, each, of ten turns of No. 24 copper wire, and are carefully balanced on the supporting point. When properly arranged only two of them can be in circuit at any one time. A current of four or five amperes will produce continuous rotation of the hexagonal helix in the earth's field with the stationary helix out of circuit. A rapid rotation is secured by holding the pole of a bar magnet near it. With the stationary helix in circuit the attraction or repulsion of parallel currents, according to the direction given the current through the movable helices, causes it to rotate very rapidly.

PROCEEDINGS

OF THE MICHIGAN SCHOOLMASTERS' CLUB AT THE THIRTY-SEVENTH MEETING HELD IN ANN ARBOR MARCH 27, 28, AND 29, 1902.

Ann Arbor
University of Michigan
1902

Michigan Schoolmasters' Club

PROCEEDINGS OF THE THIRTY-SEVENTH MEETING, HELD AT ANN ARBOR, MARCH 27, 28, AND 29, 1902

PAPERS

EDITED BY THE CHAIRMEN OF THE VARIOUS SECTIONS

GENERAL MEETING

Preparation for Life, and Preparation for College.

PROFESSOR GEORGE REBEC, UNIVERSITY OF MICHIGAN

One question usually involves many questions. When we ask, "Does the same education prepare best both for college and for life," our whole answer is contained in what we understand by "preparation for life," and by "preparation for college." To these latter questions, therefore, we must address ourselves.

I shall say my worst first. It is my opinion that the best preparation alike for college and for life is culture. I hurry to add, however, that though I mean what I say, the extravagance is rather in the term than in the thing really intended. Permit me to enlarge.

To begin with, by culture I do not mean simply the fragile fruits of a course of so-called select and high-toned studies. Culture embraces the whole substantial business of self-realization—self-fulfillment on every side, spiritual and physical,—and this not merely in a private, individual way, but of the man as a social being. It is true that the practical educator, while laboring with his whole strength to instill in the youth the love of his social self and to call forth the richest growth possible of that self, yet will always endeavor not to run counter to nature in the man. He will have regard to his primitive spontaneous ego, its quality, interests, and aptitudes, and will so try to direct him as to utilize for his social being and not merely thwart, the natural man in him. A too steady crucifixion of the flesh never leads to the highest human product, and in the average case is more than likely merely to fag and kill the life and spirit out of a man. The watchword of

modern pedagogy is, find an outlet for nature. And yet, when the situation arises wherein conflict between the private and universal self is inescapable, the private must be taught to yield. The man must be trained to the habit and strength to compel it to yield; he should be moulded to feel the joy of another and higher fulfillment of self in the very defeat of self. Self-sacrifice, duty, hardship, routine are realities in life; they are with us not only in certain grand crises of existence, but in a thousand and one trifles every day and almost every hour. I do not, under common sense, see of what else the moral conflict and hard moral lift consist. And yet, from the way in which so much of our nineteenth century pedagogy has interpreted the gospel of the "Return to Nature"—of freedom, spontaneity, and interest in education — these would seem to be things to be obviated. While as ready as any man to be dubbed an apostle of culture, I part company from the mere preachers of the pleasant. I believe education in large part to be *through* and even *for* self-sacrifice, hardship, obedience, discipline, mechanism, routine.

The just-named conditions of unfreedom, we might observe, come into the schoolroom in two ways. In part they are incidental to the carrying out of the educational program. More or less of mechanical division into grades and classes, courses of study, abstractly separate subjects, arbitrary times and seasons, more or less changing of teachers and fellow-pupils and schools, more or less in the way of interruptions and the thousand and one things we call accidents, there must always remain with us. In fact, the residue of it all will always be sufficient fully to justify the continuance of earnest efforts to overcome it. So far as it cannot be absolutely eliminated, the intelligent teacher will endeavor, to the extent that he can, to reconcile it with his purposes — he will transform his hindrances into opportunities, and make of precision, regularity, clear-cut distinction, change, intermission, etc., downright stimulants of interest and enthusiasm. For the rest, if some of these freedom-marring elements still remain over, the wise teacher will not be too distressed. He will not become a mediaeval worshipper of hardness; he will not countenance it needlessly, much less feel obliged to go far out of his way to find it; but seeing it inevitably in his path, will he not recognize that it is the very stuff of which a great part of real life is made? Real affairs do not wait upon our moods and pleasure: those of us who try to go on the æsthetic expectation that they will, know how little we do do. The dead lift is a living fact.

In part the factors of mechanics, routine, and pain come into the school because they are innately involved in education itself. You can't completely get rid of preliminary and instrumental studies, which are mere cold means to an end other than themselves. The boy who will not learn grammar, cannot know Latin. Of course, here again the educator must labor on to get rid of the old-time love of the dry and disagreeable. He may count upon it, that *serious* learning, like serious practical living and social adjustment, involves enough of the hard and unpleasant and remote without our making very special search after it. He will therefore strive, as far as in good sense he dare, outright to get rid of it; or where he cannot directly do this, he will try to transform it, by awakening an interest in it for itself through finding for it a meaning in the student's life in general; or, further still, he may frankly concede that a given study is only a means, but will try to help his pupil vividly appreciate that it is and how it is a means, and as such vital, or — last resource of all — he may to some extent legiti-

mately attempt even to arouse an adventitious interest for it. But beyond this, he will remember that he has to do here only with an illustration of a phase of the real nature of things themselves, a phase which, if he is to train for the actual conditions and activities of the world and not for a mere kindergarten paradise of pleasant illusion, cannot be blinked and sentimentally dodged, but needs to be reckoned with as a positive and radical factor in effective education itself.

Evidently, we intend that culture shall include rigor and regard for the actual serious requirements of existence. But does not preparation for life involve something more than these generalities, however excellent they may be? What shall we say once more to the never-silenced grumble of the materialistic public that the youth, whether in the secondary or any other school, ought to be learning to make a living and to do actual ordinary things? Have we not here a demand fatally hostile to the liberal sort of training we have just been describing, and may not our liberal culture itself in a way be inimical to the prosaic practicality that fits a man for the world? Though this anxiety about a living should command the respect due it as born of the immemorial grim experience of the people, nevertheless our answer too must continue to be the old immemorial one, "Man shall not live by bread alone." Especially in these days of the weakened authority of the Church must our schools be the shrines of idealism: it will be a dreary day for our civilization when we accept the motto that the whole end of life is to get a livelihood for ourselves and ours. China even has not unqualifiedly assented to that maxim. Moreover, it is not simply an ideal, but the unadorned truth that the man is more than the carpenter and the man's relations more than the carpenter's; so that the schoolmasters and mistresses who almost everywhere, at least in this land, have been struggling to keep our popular schools from sinking into mere institutes for the three R's and bookkeeping, have been waging a fight not only for idealism but for fact. And yet is there not some justice in the brusque retort of the people's elders, that for all that the man must live? Bread *is* the staff of life; and since it is the doom of the mass of men to earn their bread, why not provide for their education in the bread-studies before giving room to the studies that furnish only the desserts to life's banquet? Of course, our answer is, that the most effective way of earning your bread is to equip yourself to earn much more than your mere bread. An awakened mind, a disciplined will, ready sensibilities, and a trained eye and hand are indefinitely more to a boy or girl than any amount of mere knowledge of technical bookkeeping or blacksmithing, or cooking and sewing. Still, is this the sum of the whole matter? Is it the fact that simple intelligence in general necessarily makes the good bookkeeper, or that ability to throw the ball or put the shot trains the blacksmith's arm, or skill in picking out the shades on colored cards develops the milliner's peculiar taste? Quite obviously not. Accordingly, if the end of all education is wholeness of life, and the foundation of life is a living, why should not our schools, on behalf of the vast majority to whom the living can come only through their own making of it, provide the specific training that alone will make the making of the living possible? To be sure, it is a millennial notion to expect the schools to be able to give minute instruction in all the arts and trades; however, callings, as Professor Dewey has lately been so well pointing out, fall into typical groups. Why not, therefore, do at any rate as much as we can, by bunching our pupils together under one or the other

of these vocation-groups, according to their aptitudes and carefully observed tendencies, and instructing each as far on as possible along his proper line? The objection that of course recurs is the same one,— that in spite of all, the man is more than his trade, that there is a wider knowledge and a wider human nature, and there are wider human relationships than those of mere craft and business, and that these must not be subordinated to any mere scheme of giving the man a trade: in the competition of studies in the common school, the so-called practical must yield to the more broadly human. I agree completely with this contention, and so far enroll myself with the idealists and professors against what is usually supposed to be the position of the hard-headed practical men and business-men. Indeed, it asks no profounder reason to bring one to agree here, than to point out that any defect of mere detail of technical knowledge is more easily made up out in the ordinary world, than is a deficiency of that inward education that makes for largeness of outlook and being. Does this alternative, though, of choosing between the mercenary and the culture-studies press so hard as we are commonly disposed to think it does? I cannot help feeling but that, with the best intentions, our teachers — more especially in the high schools — have been quite wrong-headed in this connection. On the one hand, perceiving instinctively the soul-killing drift of the gospel of naked utility, they have been impelled into a blind, wholesale reaction; while on the other hand, like all the rest of us, they have been traditionally given to separating the world of studies, as Professor Dewey puts it, into two regions, — the high-toned and the vulgar; and the distinction has largely been based on whether or not the particular study had anything to do with ordinary life and affairs. Remoteness and aloofness have been supposed somehow to confer aristocracy upon studies as upon men. Now I am not ready to assert that all subjects are indifferently of equal culture-value; but I do hold that the differences have been greatly exaggerated. What is there about bookkeeping and banking or the use of machinist's tools that should make it impossible to make them play into general intellectual interest, general purpose, and even general human sentiment? Let us, besides, remember that man — and especially the child-man — is an imitative creature, and one living much in expectation, and that what he sees to imitate and what he expects to be and do, deeply stirs his interest — that motive power without whose eager response every endeavor to bring a man to selfhood is vain. But now what he sees about him to imitate, and what by the overpowering preponderance of obvious example he expects himself to be at, is precisely the common useful crafts and occupations. Our small boy, unless he is a hopeless little prig, does not play or look forward to being missionary or silver-tongued orator, but fireman and farmer. Everybody knows too the general success manual training has had in the schools with the children. The commonplace, practical subjects, it would appear, have even a certain advantage in the purely cultural aspect. I am not sure also but that the thought that the subjects are to help him earn a living will not have a certain leverage of arousing an interest in the student — an interest capable of being measurably exploited in a general cultural sense. Clearly, then, I can see no reason for not yielding to the practical fathers and mothers a large degree of what they want, — the introduction of materially useful branches to a prominent place in the curriculum of all our preparatory schools higher or lower.

Only here come in the colleges with their demand. It need not trouble us just now that our colleges have ceased to be simple in their aims and requirements, having become a sort of hodge-podge of a maturer continuation of the same culture course pursued in the high schools, and a lot of preliminary or inchoate professional studies of the true university, that is, graduate and professional school type: for our purposes, their various distinctive demands on the more elementary schools are reducible to one, —the demand for special scholastic knowledge. Now surely the preparation of men for college—which itself is but the preparation of men for forms of leadership and activity in the community without which the community is largely blind and its very everyday work largely meaningless — is a legitimate and indispensable part of the business of the secondary school. But how are we going to get this function done, if we insist on introducing into the high school all manner of studies preparatory for the world? Shall we not end in utter bewilderment with every vestige of unity and simplicity of purpose vanished from our program? No doubt, the problem is a very real one, and not to be settled by any man off-hand. And no doubt that in its settlement numerous balancings and compromises must be made. In arriving at any solutions, however, two considerations ought to be weighed. First, have we not been traveling with rather exaggerated ideas of the amount of technical, special accumulation our boys and girls must be asked to bring with them to college? I may be disclosing myself as hopelessly unscholarly, but I frankly avow that my experience as a teacher has been that, even for advanced special work, the young man or woman who, though his technical preparation be quite deficient, yet is one who has come to himself, whose mind has been found out and his free interest stirred to movement, is indefinitely preferable to the person who has been thoroughly through the formal grind, but never has come into the intellectual possession of himself. I believe, too, that this is the regular experience of teachers. But we have seen that self-development is attainable through many other than the narrowly scholastic means. Why not, then, bravely act up to our convictions and the facts in this matter of college-entrance requirements? Still, the case is not all one way here either. The boy who has not ground his Latin grammar and prose cannot expect profitably to read Horace or Lucretius, just as he cannot work his analytical geometry if he knows nothing about common algebra. The course that looks to life and that which prepares for college are not identical. Each unavoidably has its special bias; and so we are obliged to face a second consideration, namely, whether, like the Europeans, we shall not be obliged to have two distinct courses in our secondary-school system. Our American democracy, with the constant shifting of social classes and the suddenness with which, almost in an hour, the fortunes and prospects of a child in this country may alter, of course precludes of our ever drawing any such invidious line of demarcation as exists in Germany between the folkschool and the gymnasium. There must be fairly free intercommunication, a reasonably easy transition from the popular to the college-preparing course, and *vice versa*. As we have been saying, a great share of the so-called practical studies should be accepted in a liberal spirit as meeting college requirements; while everybody but a rampant champion of the three-months-in-a-business-college-and-then-into-business idea will concede that a very large portion of the more learned material has training-power of just the kind that even the plain people want. After this, what cleft remains between the college-

preparing courses and the courses preparatory more directly for life, need, perhaps, not to be so hopelessly wider than that between the boy's studies and girl's studies which nevertheless manage to subsist side by side in the same school.

However, suppose that after all is said and done, there persists a remainder of conflict between the popular and the scholastic studies, between the interests of the many who are looking towards the world and the relatively few whose eye is turned in the direction of college? I am more loath to commit myself to an answer than from my way of putting the alternative might seem. I hardly know which to prefer, or more accurately, which to esteem less, a democracy which slights its provisions for the secure prosperity of the higher science, art, and philosophy, or an aristocracy of superior culture which pursues its own concerns in abstract detachment from the well-being of the mass. Nevertheless, if we are to hold to our faith in our democratic gospel that the provision for the great majority at even a lower level is in the long-run better for society than the provision at a high level for the minority, we must, I suppose, decide that the sacrifice must be in the direction of the interest of the smaller number. In the ordinary American high school, Greek and even Latin must be prepared to take a back seat as against United States history and hygiene; and it behooves the professors of these and kindred subjects obviously for the benefit of the select college-going remnant, to ask themselves whether even now the time has not arrived for, say, such a concession to democratic prejudice as providing for beginning-classes within the college course itself, ideally or even pedagogically unsatisfactory as this, from every other point of view, may be.

A great deal of the tendency still survives among us to identify outright the scholastic, technically learned studies with the culture studies. This tendency partly springs from the natural error of confusing that which is an occupation of the few select, with what is itself select; but more particularly does it arise from tradition. First of all, it is a remnant of medievalism among us. In the Middle Ages, culture — if we may use the word in the connection — implied, not the modern pursuit of self-realization, but the literal gospel of self-renunciation. Even the moderate maxims of the time call, in all things, for humility and obedience to authority. The striving everywhere is to exhibit the spirit submissively receptive, disciplined, mortified; and these things are what constitutes mundane culture — if such a thing may be said to exist at all for an era to which the soul's proper being lies only in a blessed vision of the Beyond. For such an age, clearly, there can, in the training of the mind, be no harm but only virtue in reducing study to mere vigils of memory and painful persistence backed by literal physical fast and flagellation; just as for it the baldest, most formal grammar, rhetoric, logic, or arithmetic are genuine culture-studies; because for it the relation of studies to interest and the free natural life of the spirit is a matter only of negative concern. For such an age, clearly, culture can be only an external thing. When the Renaissance appeared, it is true it changed men's mood and reinstated the ideal of self-development; so that no longer could culture be submerged in the sapless learning that to this day is called scholastic. Nevertheless the new ideal of culture was obliged to be largely reminiscent — its best stimulus and suggestions were to be found back in ancient Greece and Rome. Therefore bare learning, though it ceased to have a cultural virtue in itself, became emphatically the

key to culture; and because it was the key to culture, men, by a natural piece of ill-logic, encouraged by a historic reaction towards mediaevalism which we cannot here enter upon, identified it with the substance of culture; and they continue numerously still to do so. Both the mediaeval and the later reactionary exaggerated conceptions of the worth of formal learning still largely prevail in our schools; and yet the simple fact is, that those studies whose obvious first distinctive mark in the high school is that they are technical preparation to special advanced work in the college, as regards their cultural value resemble more closely than any other branches those very practical ones against which, in the name of culture, they so often wage war. Culture, whatever else it includes, presupposes ideas, and sensibility to ideas, outlook, perceptive insight, and the living spirit; but wherein (to be moderate) does the first year of Latin, or Greek, or French, or a good deal of mathematics as taught, further all this markedly better than say so much household-economy or shopwork? I do not assert that scholastic studies — the most undisguised of them — have no cultural worth; nor that this worth cannot be increased; nor even that any irreducible remnant of dead weight about them is an unmitigated evil; but only that their real justification in the secondary curriculum remains their instrumental character, while their cultural quality for the most part is subordinate — in some respects inferior to that of the despised bread-and-butter subjects, which possess the interest of direct utility and relation to life. If this fact were better realized, it might spare us, for instance, such heaven-crying spectacles as a principal trying to induce a lad who in all human likelihood will never see the inside of a college, to take the high school two-years course in Greek, "because of the superior culture there's in it"!

All that we have so far said, throws light on what are the rights and proper place of those higher professional studies that nowadays are crowding their way down not only into the college but the high school courses. The attitude of educators towards these higher practical studies has been very much the same as towards the humbler practical ones. Teachers have been prone to feel as Aristotle did, when he forbade the young citizens of his ideal commonwealth not only to perform music professionally, but even to acquire skill up to the professional point. Professionalism seemed, to Aristotle, to introduce an illiberal element into education, and to distort the man from the pursuit of an unbiased, symmetrical self-development. Aristotle overlooked the possibility that a man *may* truly realize himself in a vocation. Also he did not contemplate a social order other than his own,—one in which every man *must* bend himself to a special function, there being normally no provision, on the one hand, for an aristocratic leisure-class which shall be exempt from the necessity of any calling in particular, and, on the other hand, for a servile class doomed inexorably to the dull, deforming round of narrow toil. Lastly, Aristotle and his followers have forgotten that general culture is not gotten through studies in general, but must be worked out by every man along his own line—yea, even if it be his professional line,—and must gain its breadth by being carried so deep and far as to be brought into connection with things and life in all directions. However, if such has been our mistake in the past, just at present we are drifting into notions exactly the reverse. Members of college faculties are breezily advocating the proposition that a man's general culture will take care of itself if he only thoroughly turns his

attention to getting his profession—and then getting his profession is interpreted in the narrowest technical sense. What are we to say to this new doctrine? I for one confess that I am bewildered in the presence of a pedagogical philosophy whereby Plato, Shakespeare, and the New Testament become educational aberrations, or something to be consigned to private reading-circles and the Sunday schools. I still must hold that the very heart of education is general culture—ideas, broad human sympathies, and broad human capacities. In the secondary schools, and in the college itself so far as it continues a part of the secondary school, professional studies have a place only in so far as they are soundly reconcilable with the more vital concern of culture. They have even less right there than have the vulgarer useful studies in the lower schools, because they are not a concession to an urgent need of getting a living. The proper place for strictly professional studies—for the preparation of doctors, lawyers, bankers, foresters—aye and teachers too, is in the graduate and professional school; and even there—as all enlightened judges will urge,—they should be conducted on a broadly liberal foundation, with a broadly liberal outlook.

In conclusion, let us summarize quickly. The aim of the secondary school properly is and must remain culture. However, the hostility of practical and professional studies to culture is not so great as has, under the influence of tradition and false aristocratic feeling, been too usually assumed. Furthermore, this incompatibility may, by enlightened teaching, be still further diminished—to the benefit of the useful and professional knowledge itself. Lastly, in the working out of these matters, at any rate in the more popular schools, it is the distinctively learned subjects that must expect to make most concession, though the serviceableness of these branches themselves to the cultural ends that are at the bottom of the schools, is capable of very large increase.

ENGLISH SECTION

Discussion of English Masterpieces Required for Entrance to College

PRINCIPAL JAMES H. HARRIS, MICHIGAN MILITARY ACADEMY

At the outset permit me to say that my discussion, while including the subject as given above, will take a somewhat wider range, and besides discussing some of the particular books required for college-entrance, will consider some of the principles and conditions which underlie the choice of reading matter, and which should, in a measure, determine the selection.

Last summer in a paper read before the English Section of the Department of Secondary Education at Detroit, I expressed my belief that the adoption of unified requirements in English was a necessary and eminently progressive step in the evolution of the English curriculum. The chaotic conditions that prevailed,—both on the side of the colleges, no two of which made the same requirements, and the secondary schools, where individualism had run mad,—were so subversive of economy of effort and of unified and satisfactory results that it became imperative that the atmos-

phere be clarified, the woful waste of time and energy remedied and the English requirements brought by force into something of unity and order. This step, as I have intimated, was absolutely necessary to the integrity, security and continued effectiveness of the English curriculum, and receives its justification in the unquestioned good it has done in bringing order out of chaos and in attaching some measure of unity and fixity to the work in English. All praise should be given to the Committee on College Entrance Requirements in English which so bravely attacked so serious a problem and so successfully worked it out.

But that step, important and beneficial as it was, can hardly be looked upon as final. At best it was a unity forced, artificial, superimposed. It is not a unity from within, possessing the vitality and permanency of life, but is an artificial unity and only of service as it is a necessary step in the evolution toward the higher unity. For of all the branches of instruction in the program of studies, English is, of force, the most fluent and plastic, the least susceptible to rigidity and inflexibility either in form or content. The time can never come, I believe,—until English takes its place among the dead languages,—*Dei diem avertant!*—when the curriculum in English can be as determinable, as restricted, and as final as in the Ancient Languages or in Mathematics. The ends and aims of instruction may, and, I believe, will be more clearly defined, but the means by which those ends are attained will ever vary. So long as English is a living tongue the attempt to give rigidity and permanency to the curriculum cannot but fail. The very term "College Entrance Requirements" indicates at once the source, the strength and the weakness of the existing situation. It is the ever-present witness to the fact that the unity is imposed from without. In a time when the colleges and universities are less and less given to imposing their will upon the secondary schools, we find the rather anomalous condition of a consciously imposed curriculum. Yet it was a necessary imposition, and a situation which the secondary schools seemed unable to cope with alone had to be taken in hand by those in the higher institutions. This is a source of strength, but it is also, as I have intimated, a source of weakness, and the time must come when the problem will be solved from within on the basis of a sound psychology and of sound logical and historical principles. What I mean by this will appear from a study of the conditions which gave rise to the necessity for the interposition of higher authority to bring into order a distinctly chaotic condition. Those conditions were, first, a hazily defined curriculum; second, an absence of specially trained teachers; third, an inadequate time allowance; fourth, the difficulty of fitting students for a most varied assortment of entrance requirements; and fifth, a lack of suitable texts suitably edited. Out of these conditions grew the necessity for collegiate interference and guidance. But these imperfect conditions are in some particulars wholly remedied, in others rapidly becoming so. We are attaining a more definite conception of the end and purpose of our English instruction; we are granting it a larger allotment of time; we are equipped with numerous and suitable texts—good tools with which to carry on our craft;—we are strengthening our course of study; and above all—and the underlying strength of all—we are securing a body of teachers trained for this work as are those in the Foreign Languages, in Science and in Mathematics. With the removal, by a natural process of growth, of the conditions which brought about the imposed curriculum in English, we may look for a reconsideration of its

claims to permanency, and discover whether, in the light of the new conditions, certain modifications may not be necessary and some revision of the principles upon which it is based be formulated.

The basis, then, of the reconstruction I have in mind lies in the thought of an inner unity as contrasted with an outer, artificial unity. I acknowledge that the superimposed unity is easier; it relieves us from all care and responsibility; it says 'do this' and we do it:

"Ours not to reason why,
Ours but to do or die;"

it makes us secondary clay in the hands of the University potter, and while it may manifest the surpassing artistic cunning of the potter, it,—well, it makes and keeps us just clay!

The elements of this inner unity are three in number, and out of them, I believe, the English curriculum will ultimately be constructed. These elements will be determined, first, by a wide and comprehensive study of the tastes, interests and intellectual attainments of the pupils of secondary age; second, by an exhaustive and scientific study of the books and literature adapted to each particular grade or age; and third, by a study of the principles underlying the historical development of literature. If a course of reading based on such a sound philosophy and psychology as this could be elaborated, the inner unity for which I plead would be attained and the most satisfying results would be achieved. The question of adequate preparation for college, too, would solve itself, and the pupil who was best prepared for life on such a program would of necessity be best prepared for college. We hear much about the best preparation for college being the best preparation for life, but I say the best preparation for life is the best preparation for college.

A PLEA FOR WIDER OPTIONS IN READING MATERIAL

But for the present my first practical application of the theory that the English curriculum must be built up from within and must rest on a study of the conditions and factors that are predominant in the secondary school period, is the recognition of the principle of wider options in our reading material. But, you will say, that involves a reversion to the chaotic, disorderly individualism of the days which we are glad to think are no more. No, I do not mean such a wide-open policy as formerly prevailed; I mean freedom within certain well-defined limits; I mean that instead of four books absolutely and undeviatingly required there should be a list of eight or ten books from which choice might be made; I mean that instead of ten books for general reading, a list of twenty-five should be made within which the teacher might select those best adapted to local or individual conditions or most consonant with his or her own interests, tastes and studies. I am well aware that teachers of sufficient training, literary taste, breadth of view and good judgment to select what is best on any scientific principles, without reference to some idiosyncrasy or one-sided interest, are extremely rare. And to leave complete freedom to these would be to invite a return to those conditions which we all so much deplored. But selection within such limits as I have suggested would, on the one hand, sufficiently safeguard the interests of the curriculum, and, on the other hand, give adequate freedom to that growing class of teachers, who, with a splendid equipment in English, are sanely judicious enough to use the restrictedly wider opportunity to the enrichment of their own souls, the

enlargement of the mental horizon of the pupils and the betterment of the curriculum. To many a well endowed and adequately trained teacher the narrow restrictions of the College Entrance Requirements are a source of baffling discouragement. Seeing the rich feast before their eyes, like Tantalus, they may not taste of it. Shall they constantly be so tortured? Out of the surpassing richness of our unrivaled literature are there only four books which can be carefully studied to advantage and profit? Shall the whole fabric be sacrificed to convenience? The number of books constituting the body of good and imitable literature—literature which it is not only worth the pupil's while to absorb, but which he is prepared to absorb—is so large, and the line of cleavage between the one gem of literature and the other is so fine that it is out of the question to reject the one and insist on the other, save on the assumption of an artificial convenience and a forced requirement.

This leads me naturally to consider the claims of some of the books which are set for careful study and general reading, and to raise the question, *not* whether they should be discarded but whether a wider option might not be allowed. I have no thought in my mind to question the claims of the books recommended, to a place in the hierarchy of English masterpieces. Every one of them is admittedly included in that sacred circle and I would not wish to seem even to question the claims of these masterpieces to a place in that list. I shall merely consider one or two of them in the light of their adaptability to secondary school conditions and their claim to *exclusive rights* as the objects of literary study.

The first masterpiece to which attention is called is Tennyson's Princess. While it is true that this poem is not included in the list for careful study, it is included in the list for general reading, and must perforce be given a place somewhere in the curriculum to the exclusion of something else. There is no question of the artistic greatness of this poem, and some of the intercalary lyrics, notably "The splendor falls on castle walls" and "Tears, idle tears, I know not what they mean," are among the most beautiful in English literature. But why wade through an interminable discussion of the equality of the sexes in order to get a few gems? To boys especially the task of toiling through this long poem is discouragingly dreary and there is great danger of creating in them a distaste for the master poet of English form and versification which they may not ever overcome. It would seem to me that the approach to Tennyson might more happily be made through other avenues.

The second masterpiece for which an option might very reasonably be offered is Burke's Speech for Conciliation. Not that I would exclude it from the list, for its historical as well as its oratorical value amply justify its selection as an example of the form of literature of which it is so splendid a representative, but there might be conditions which would make the selection of another piece of oratory more serviceable, and for the benefit of these an oration of our own Daniel Webster or Wendell Phillips might well be substituted. To drag a class largely composed of girls, for instance, whose argumentative stock in trade usually consists of one word, thro' Burke's elaborate and often fine-spun arguments, is a task to test alike the patience and the wits of the most dauntless teacher.

The cultivation of a style like Burke's would be an anachronism. Why then devote so much time to it or lay so much stress upon it? In the study of Burke the teacher is much of the time warning his class against

his florid diction, his rhetorical digressions, his effusive classicism. No speaker of this day would think of constructing a speech in imitation of Burke. The whole spirit and atmosphere of modern times calls for oratory —even argumentative oratory—of an entirely different type. Again, it requires mature and trained thought to follow Burke's involved argument, and it is doubtful whether, unaided, the average boy or girl in our secondary schools would be able to give an outline of it. And I am inclined to think, as a result of experience and observation, that a practical example of argumentation less complicated and less ornate would better accomplish the purpose in many instances.

I have no thought, let me repeat, of decrying the greatness or importance of the speech. It is one of the masterpieces of one of England's master orators. But I would question the propriety and value of forcing a lot of boys and girls thro' it, especially under a teacher whose appreciation of closely reasoned and logically constructed argument is circumscribed by sex. I should place the oration in the list of books for careful study, but make it optional with one or two other orations such as those suggested above, and let the individual teacher's judgment determine whether it is the best book for careful study with that particular class.

Another bit of literature I should venture to raise some question about is Milton's Comus. Not but that the poem has literary and artistic excellence of a high degree, and moral tone of an unimpeachable character. The trouble is the poem is so flagrantly and flauntingly moral that it vitiates the art.

I have not time to enter into further detailed discussion, but I cannot close without referring to the conspicuous lack of American masterpieces on the list. I am far from being so scoundrelly in my patriotism that I see nothing good in other than the American brand. At the same time one cannot be charged with extravagant patriotism in claiming that at least five or six of our writers are deserving of recognition.

To sum up, then, I would plead for a list of ten books instead of four among those recommended for careful study, from which the teacher might select the four best adapted to her needs and tastes. I would favor a list of twenty-five books for general reading, selected with some reference to historical sequence and to the interests and attainments of the pupils, and in doing that I could not but include at least a few of our American authors. In this way, I believe, we would secure sufficient rigidity to satisfy the convenience of college-entrance examinations and at the same time give sufficient flexibility to the curriculum to broaden the interest and stimulate the activities of our best teachers.

Composition Teaching in the Schools of Mississippi

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It is a significant fact that President Eliot speaks of the introduction of systematic instruction in the English language and literature into the secondary schools as a "tendency." "It may be spoken of," says he, "as a tendency, because the best methods and legitimate aims of this instruc-

tion are still under discussion, and are still being developed by continuous experiments in innumerable schools." However disposed we may be to resent the word "tendency" in this connection, a very little consideration of the question will show that President Eliot is right. Though the study of English is now receiving more attention in the secondary schools than ever before, yet the methods and aims are so varied that we must still call the whole movement a tendency rather than an assured triumph. Both of the constantly recurring questions in pedagogics, "What shall I teach" and "How shall I teach it," have been answered in substantially the same way by all teachers of Latin, Greek and Mathematics. In English, however, there is a wide divergence of views as to the proper answer to each. In no other department of study, perhaps, has the teacher freer play for his personality, and greater opportunity, therefore, for the display of originality, and, I may add, of eccentricity. But in education, as in government, excessive individualism is as dangerous as a mechanical uniformity. The ideal educational system is an organic whole. It may not be unprofitable, therefore, for us to consider again the much discussed question of English composition teaching.

The ideas advanced in this present paper have been put into shape after an investigation of the methods and aims in the teaching of English, especially composition, in the secondary schools of Mississippi. This investigation was made because my contact with themes written by college students had brought me to the conclusion that, since the schools were not achieving success in this line of work, there must be something wrong in the methods used. This belief led me to prepare a set of questions to be answered in writing by all Freshman students in the University of Mississippi. These questions touched upon their preparation in grammar and spelling, in composition and rhetoric, and in reading the prescribed masterpieces. I carefully read the ninety-four sets of answers, representing in all forty-two schools, and took full notes of their contents. In this way I gained an insight into school methods which could not have been gained in any other way. Though I believed that the students had answered the questions in perfect good faith, in order to make assurance doubly sure, I verified the information obtained by inquiries made of principals and teachers in the secondary schools. Hence I believe the picture I present is a just one.

Let us see what the conditions in regard to composition teaching are. The first general conclusion that would be drawn from these papers is that the schools taken collectively do not exhibit any uniformity in their English instruction; they differ widely in quantity of work done, in quality, and in their estimate of the ultimate object of instruction. The question, "How many of the prescribed English masterpieces were read in direct preparation for college?" drew forth a great diversity of answers ranging from "all read" to "none." Many said that they had read a few of the masterpieces and parts of some others. From the answers to other questions it was evident that in only a few schools was there even the most superficial connection between the literature study and the composition work. Here is an answer which gives, it seems to me, the average situation: "I read some of the required books merely for the substance and the pleasure I could get out of them, and did not make them a study, so of course they were not explained to me or discussed by me in class, and I never made them the subject of a written exercise." Another wrote: "Each work

was read entire, and special stress was given to word study and derivation and telling the figures of speech. The works were used as a subject in written exercises."

The answers to the question: "How much time was spent in your school in English composition? What was the length in words, approximately, of each written exercise?" exhibit great diversity and weakness. One student writes: "It was every day (30 m. recitation) two terms one year, and our essays were 800-1000 words." It is almost impossible to tabulate the answers to this question. For this the schools, in a great measure, are themselves responsible. They represent extremes. Some schools spread the instruction in composition over the entire course, giving a moderate amount each week. Others, again, seem to concentrate all the composition work into one year. But of all the schools, except a very few, it would be perfectly safe to say that the aggregate amount of work is quite inadequate. The general rule seems to be that the difficult art of writing the mother tongue is to be taught by having perhaps only one hour each week devoted to it, and by requiring pupils, once every month or two, to perform the drudgery of writing a long 1000-word "composition."

The answers to the question "Did you study any text-book of rhetoric? What was the nature of the instruction?" were confusing. Very many students answered as if rhetoric was an entirely distinct subject from composition, something to be studied on its own merits without regard to their writing. This conception is inevitable, one may say, in a school that disposes of rhetoric in a term or two by recitation only or mainly.

Some remarkable answers were given to a question about the kinds of subjects on which students had been required to write. Thus one writes: "Subjects were usually given us by the teacher; e. g., 'Bees,' 'Character,' 'Napoleon Bonaparte,' 'Mountains,' 'The Last Time I Went Fishing,' 'How I Spent My Vacation.'" Another says: "Our subjects were chiefly argumentative, or on some current topic of interest: 'Temperance vs. Total Abstinence,' 'Canada should be annexed,' 'Our War with Spain,' 'Fairies,' 'Rats,' etc." I do not believe the answer was intended for an anti-climax.

To the last question asked: "State any other facts that may aid in forming an estimate of the work actually done in English in preparatory schools. How much time and attention did English receive in comparison with other subjects? Were your written exercises or examination papers in mathematics, Latin, history, etc., corrected for faults of spelling and expression?" the answers were in the main not clear. Evidently not many of the writers were accustomed to summing up the operation of a study running through more than one year, and their memories failed them. The inability betrays, I think, a defect in the training itself. The same writers would have done better if asked to recapitulate their course in Latin or mathematics. The answers to the second part of the question: "How much time and attention did English receive in comparison with other subjects?" were in three groups. One group maintained that English received fully as much attention as any other study and justified the assertion by the superior quality of the papers. Another group took the same ground but denied the assertion by writing extremely poor papers. The third group, the great majority of the class, were either noncommittal or inclined to the view that English did not get an equal share of attention.

To the last part of the foregoing question: "Were your written

exercises or examination papers in other studies corrected for faults of spelling or expression?" very few gave satisfactory answers. Many gave no answer at all. Some stated that occasionally a fault in spelling (but not in expression) had been corrected in such written exercises. Only a very few were able to give the assurance that their general school work had been thoroughly corrected for poor English. Such are some of the facts.

One general conclusion, I think, must be drawn from these papers. Or rather, one general conviction forces itself upon the reader. It is that the work in English composition is not giving satisfactory results. What is the remedy for the failure on the part of the secondary schools in this respect? The schools have the remedy in their hands, but many of them fail to see it because, like most genuine remedies, it is very simple. Perhaps it has been overlooked or misapprehended precisely because it is so simple. Were it more complex or more mysterious, it might succeed better in commanding regard. The remedy consists, to put it into a short phrase, *in changing school English from a study into an art.* The teachers of composition have forgotten the commandment: "Thou shalt always hold practice primary in thy teaching of composition; theory thou shalt regard as only secondary." This, broadly speaking, is the cause of the failure, so far as it may be called a failure, in teaching composition. For convenience in applying the remedy, we may, in our diagnosis, attribute the ailment to three causes: 1, The essays required are too infrequent and too long; 2, the distinctive function of composition work is not regarded; 3, the printed page is not made the supreme teacher of composition. Taking up these reasons in the order of their statement let us attempt to make some suggestions by which matters may be improved. I am sure that no true teacher in Mississippi would deny that the only royal road to success in composition is to practice writing, and I am equally sure that many teachers yearn to follow this method in their schools. But they are handicapped by difficulties of several kinds, two of which, at least, will at once suggest themselves: 1, The pupil does not have time or inclination to write as many compositions as his teacher knows he ought to write; and, 2, the teacher does not feel that he has time to correct as many exercises as the pupils ought to write. Yes, English composition is one of the bugbears of teachers and pupils alike. The pupils find talking so much easier than writing that the latter seems a wanton retardation of utterance; while the teacher inwardly sighs as he sees the composition papers piling up and reflects on the unmitigated tedium of correction that is in store for him. Indeed, many a teacher wears himself out correcting papers and is nevertheless forced to look back over the work of the session with feelings far from complacent. And yet, no faithful and observant teacher can doubt that pupils learn to write only by writing; and that it is the duty of the teacher to correct rigidly every written page that the pupil submits. The difficulty in the whole matter, I think, lies in the fact that the compositions demanded are not too many, but too long. We expect the pupil to write a composition as soon as he has learned to write a sentence. In other words, we try to pass from the sentence to the composition, making the sentence the unit of composition. The unit of composition (a composition being a structural aggregate) is the paragraph. We should pass, therefore, from the sentence to the paragraph, then to the composition proper. Drill the pupil in the paragraph, which is nothing more than a

cluster of sentences dealing with a single topic. Let the paragraphs be short, not more than ten or fifteen lines at first, but see that they have unity and symmetry. Spend months on this; for the paragraph is the composition in miniature.

In other words subdivide your topics into small parts and drill on each separately. Let me illustrate. Suppose you desire a composition on "A Day's Hunt." Let the pupils write separate paragraphs on: 1. How I Longed for the Day to Come; 2. The Start; 3. My Companions; 4. Our Dogs; 5. The First Game; 6. A Bad Shot; 7. A Shower; 8. Our Lunch; 9. An Accident; 10. Something Funny; 11. What We Killed; 12. Our Return.

Now if these paragraphs or miniature compositions are short, the teacher can correct them not only with less expenditure of time but with more efficiency than if four or five pages had been written. After a drill in this way, assign the entire topic, "A Day's Hunt."

Great difficulty is sometimes found in securing and assigning appropriate topics. The difficulty chiefly arises from failure to remember the distinctive function of composition teaching. The aim is not to give the pupil information on the topics chosen, but to teach him how to arrange and present the information already in his possession. I am speaking always of secondary work, not of the collegiate period when the student may sometimes fairly be expected to "work up" a given subject. Topics, therefore, about which the student is ignorant should not be assigned, even though the source of information be ready at hand. Exercises in composition should not be intended to teach new facts, but to teach how to systematize and present facts already known. The difference is that between gathering flowers and arranging them into bouquets. The pupil is supposed to be culling from every book that he studies, to say nothing of the wider fields of experience and observation; but work in composition has as its distinctive function the orderly arrangement and expression of thought won from any field whatsoever. I emphasize this because I believe that just in proportion as the pupil has to collect information upon his topic to that degree he expends the time and thought that should have been put upon arrangement and expression.

I have said that composition differs from other subjects in that it deals not with amassing information, but with presenting it. Let me mention one other distinction, which is at the same time an advantage, which gives the teachers of English composition finer opportunity than the teachers of any other department have. It is this: every page of print that the pupil reads, every book that he studies, may be made to contribute to the correctness of his style. Whether it be arithmetic, geography, history, or botany, if he has inculcated in him the habit of close scrutiny of the written page, he is daily absorbing the principles of spelling, capitalization, punctuation, sentence structure, and paragraphing. This gives the teacher of English an incalculable advantage, due solely to the fact that all the information that the text-books yield must reach the pupil through the medium of written English.

This consideration, therefore, should largely control the teacher's method of dealing with composition work. He should strive to develop in the pupil, at the earliest possible stage, the habit of close observation of what he reads. The problem is to establish such a relation between the pupil and the written page that every book read shall contribute to his

knowledge of correct form. I make a plea for a more fundamental use of literature in composition teaching than the connection ordinarily made now between the two—the mere drawing of subjects for compositions from the books read. Just as the mineralogist sets an assortment of minerals before his pupils to be analyzed, or the botanist hands them a flower, saying "Examine minutely and report;" so the teacher of elementary English should insist that the pupil *scrutinize* what he reads. The printed page should be to the student of English composition what the mineral is to the student of mineralogy, what the flower is to the student of botany, what the map is to the student of geography, what the insect is to the student of entomology.

If the pupil leaves your schoolroom without having acquired the priceless habit of observation, then you have failed to avail yourself of the distinctive advantage already mentioned; you have failed to make his knowledge of good writing self-sustaining. He may read hundreds of good books without adding appreciably to his store of form, of expression, of correctness in all the details of written English because you have never put him in touch with books as the supreme teachers of composition.

How may we best accomplish this? By selecting topics, whenever possible, from the books that your pupils are using; and by selecting chiefly with the end in view of focusing the pupil's attention upon the spelling, punctuation, paragraphing, and general structure of what he is reading. But before doing this, I have found it of great benefit to have the pupil do no little copying. I do not believe that twenty-five per cent of the students in the freshman classes of our colleges can sit down to a page of conversational English and copy rapidly without error. It demands an eye open to everything on the page; it inculcates, if kept up, habits of scrutiny that will serve the pupil in every department of effort; above all it tends to make him depend for correctness more on observation and less on memorized rules; it develops the inductive sense and leads the pupil gradually to see that the rules of correctness in writing are nothing more than attempts to formulate into a system the uniform practice of good writers; and, lastly, it makes the pupil's skill in composition grow as a rolling snowball grows,—by attaching to itself what it comes in contact with.

No study of formal grammar, no acquaintance with rules or text-books, can take the place of constant scrutiny on the pupil's part of what he reads. Indeed, until the habit of close observation has been established, books on composition amount practically to nothing.

Perhaps you may ask, "Will not this unremitting attention to details that are merely formal and external divert the pupils' minds from literary beauty? By no means. You must keep it up until it becomes a second nature to the pupils, until it ceases to be an effort; just as walking, skating, dancing soon cease to be the awkward displays that they at first were. Surely Benjamin Franklin's style was not injured, nor was his literary sense dulled by his technical knowledge of type-setting and proof-reading. Shakespeare was not a worse dramatic writer because he was an actor and knew all the formal details of his craft. Whatever awkwardness may appear at first will pass away as soon as this attention to the minutiæ of composition shall have become an ingrained habit. Besides, in insisting that your pupils use their own eyes and make the attempt to formulate their own principles of expression, you are teach

ing English composition exactly as all scientific branches are taught today. If there is one tendency in pedagogy that cannot be mistaken by even the most casual observer of methods, it is the tendency toward having the pupils learn at first hand. There are too many *media* interposed between the learner and the thing to be learned. The old way was to lead the pupil all around a topic, but rarely, if ever, to let him put his hands on it. Modern methods demand that he get a hand grip on it at once, and then circle around it to his heart's content.

Let me return, by way of conclusion, to the subject of topics. After a drill in mere copying, assign topics from some literary masterpiece that your pupils are reading. If, for example, it be "Rip Van Winkle," I should have them ascertain and write down in their own words the subject of each paragraph in the story. I should then assign, with books closed, one of these paragraph subjects as the topic for an exercise in reproduction. Keep this up, day by day, until every important paragraph shall have been reproduced in their own words. Then take the leading characters: Rip, his wife, his son, and Nicholas Vedder. Assign these in like manner as paragraph topics. Such exercises soon beget in the pupil the habit of minute observation, not only of the features of the story, but equally of the general details that constitute correct writing. His vocabulary will almost insensibly be enlarged. The certainty that he will have to reproduce in writing what he is reading will soon implant the habit of scrutiny; and when this is done the pupil is on the road to assured mastery in English composition.

It is needless to say that I do not advocate holding the pupil back in his reading of English literature until every masterpiece shall have been treated in this way. I except, also, poetry from the material proper for drill in composition. Select only prose, and the simplest prose possible. Irving, by the way, is far from being the best writer for reproduction exercises. In a word, I am not presuming to dictate authors, topics or method; but I do urge you, fellow teachers, to lay supreme emphasis on the development of the pupil's own powers of observation, remembering that these are just the powers that are now most active. Select any method that will lead to this goal, but keep this goal always in sight.

MATHEMATICAL SECTION

Some Recent Discussion of the Teaching of Mathematics

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I was led to select this topic for this afternoon by the fact that at the Glasgow meeting—held last year—of the British Association for the Advancement of Science, the section on mathematics and physics and the newly organized section on education had a joint session at which the principal paper was read by Professor John Perry of the Royal College of Science, London. This paper, as was intended, provoked a good deal of

discussion, which was followed by the appointment of a representative committee with Professor Forsyth of the University of Cambridge as chairman, "to report upon improvements that might be effected in the teaching of mathematics, in the first instance in the teaching of elementary mathematics, and upon such means as they think likely to effect such improvements." Professor Perry's paper was published in the *School World* for October, 1901, and the accompanying syllabus in the November number of the same journal. Later Professor Perry edited a book of one hundred pages, published by the Macmillan Co., containing his address, syllabus, reports of the discussion, together with written remarks from fourteen mathematicians and teachers of prominence who were not present at the meeting, and a reply by himself. I may add that the address was given in full in the *Educational Review* for February, 1902.

This discussion of the teaching of mathematics in England particularly with regard to the retention of Euclid as a text-book of geometry is by no means a new one. De Morgan, one of the best teachers of mathematics England ever had, in his article on "Mathematics" in the Penny Cyclopedia, and in substance in other places, says: "The work of Euclid is preferable in our opinion to any system which has been proposed to supply its place: simply because the dependence of conclusions upon premises is more distinct than in any other geometrical writing. The defects with which it abounds (and DeMorgan was both logician and mathematician enough fully to appreciate them) are trifles which can be remedied as they are met with; and though there are seldom three propositions together, one or other of which will not call for some remark from the teacher, yet such is Euclid that these very faults properly noted, are of more value than the greater elegance and more artificial process of less formally vigorous writers." On the contrary, Sylvester, whose enthusiasm bred contagion wherever he taught, whether in England or America, in words often quoted from his presidential address to the mathematical and physical section of the British Association in 1869, says: "I should rejoice to see mathematics taught with that life and animation which the presence and example of her young and buoyant sister (natural and experimental science) could not fail to impart, short roads preferred to long ones, Euclid honorably shelved or buried 'deeper than ever plummet sounded,' out of the school boy's reach, morphology introduced into the elements of algebra—projection, correlation and motion accepted as aids to geometry—the mind of the student quickened and elevated and his faith awakened by early initiation into the ruling ideas of polarity, continuity, infinity, and familiarization with the doctrine of the imaginary and the inconceivable." He confesses: "The early study of Euclid made me a hater of geometry . . . and yet in spite of this repugnance, which had become a second nature in me, whenever I went far enough into any mathematical question I found I touched at last a geometrical bottom." Again, Todhunter, the teacher, examiner and English mathematical text-book writer *par excellence*, in a 56-page essay on Elementary Geometry, wields the cudgels most vigorously in favor of a strict adherence to Euclid. He suggests that the grounds of Sylvester's dislike may have been "only the repugnance which might naturally be felt by a creative mind conscious of the power to advance without any superfluous aid," and says: "Tradition seems to record such characteristics of Newton and Pascal. It would be unwise, however, to suppose that such exceptional cases are likely to be common."

The opposition to Euclid in England seems first to have taken definite form in the organization in the year 1871 of the Association for the Improvement of Geometrical Teaching, whose object, as stated in the Code of Rules, "shall be to effect improvements in the teaching of elementary mathematics and mathematical physics, and especially of geometry." This association has published a syllabus of plane geometry, a syllabus of modern geometry, and a text-book entitled Elements of Plane Geometry; but by reason of the undisguised hostility of various boards of examiners, it has accomplished comparatively little. The present revival of the discussion is due to the untiring activity and zeal of Professor John Perry, whose charming naiveté is not concealed even in his text-book on the calculus. For twenty-odd years, in season and out of season, with reason, and sometimes, I fear, without reason, he has preached on "England's Neglect of Science," "The Defects in the Teaching of Mathematics," and similar subjects, till finally he secured a hearing before the two sections of the British Association in September, 1901. As early as July he notified those who were expected to take part in the discussion, of the date assigned for the reading of his paper, September 16, and had copies of his paper printed for distribution before the meeting; but a change to a date three days earlier was found imperative, so that some of the expected speakers did not reach Glasgow in time, while those who were present did not have the wished-for opportunity carefully to examine the paper before the discussion. Still the written remarks from various contributors now published with the address, render this change of slight consequence.

Professor Perry was very much in earnest. He begged his auditors to give him the benefit of their severest criticism and advice, and said: "Anybody who thinks I am making a mistake, or who sees how my method may be improved, and who holds his tongue, is doing a real harm to the country." As would be expected from a teacher in a technical college, Professor Perry is a staunch believer in the utility of mathematics. The obvious forms of usefulness in the study of mathematics he enumerates as follows:

"1. In producing the higher emotions and giving mental pleasure. Hitherto neglected in teaching almost all boys.

2. (*a*) In brain development. (*b*) In producing logical ways of thinking. Hitherto neglected in teaching most boys.

3. In the aid given by mathematical weapons in the study of physical science. Hitherto neglected in teaching almost all boys.

4. In passing examinations. The only form that has not been neglected. The only form really recognized by teachers.

5. In giving men mental tools as easy to use as their legs or arms, enabling them to go on with their education (development of their souls and brains) throughout their lives, utilizing for this purpose all their experience. This is exactly analogous with the power to educate one's self through the fondness for reading.

6. Perhaps included in (5): in teaching a man the importance of thinking things out for himself and so delivering him from the present dreadful yoke of authority, and convincing him that whether he obeys or commands others, he is one of the highest of beings. This is usually left to other than mathematical studies.

7. In making men in any profession of applied science feel that they

know the principles on which it is based and according to which it is being developed.

8. In giving to acute philosophical minds a logical counsel of perfection altogether charming and satisfying, and so preventing their attempting to develop any philosophical subject from the purely abstract point of view, because the absurdity of such an attempt has become obvious."

He believes most sincerely that these desirable functions would be performed well under the new system which is suggested. It may be well to quote a characteristic passage: "The ancients devoted a lifetime to the study of arithmetic; it required days to extract a square root or to multiply two numbers together. Is there any great harm in skipping all that, in letting a boy learn multiplication sums, and in starting his most abstract reasoning at a more advanced point? Where would be the harm in letting a boy assume the truth of many propositions of the first four books of Euclid, letting him accept their truth partly by faith, partly by trial? Giving him the whole fifth book of Euclid by simple algebra? Letting him assume the sixth book to be axiomatic? Letting him, in fact, begin his severer studies where he is now in the habit of leaving off? We do much less orthodox things. Every here and there in one's mathematical studies one makes exceedingly large assumptions, because the methodical study would be ridiculous even in the eyes of the most pedantic of teachers. I can imagine a whole year devoted to the philosophical study of many things that a student now takes in his stride without trouble. The present method of training the mind of a mathematical teacher causes it to strain at gnats and to swallow camels. Such gnats are most of the propositions of the sixth book of Euclid; propositions generally about incommensurables; the use of arithmetic in geometry; the parallelogram of forces, etc.; decimals. The camels I do not care to mention because I am in favor of their being swallowed, and indeed I should like to see them greatly increased in number; these exist in the simplest arithmetic, and geometry and algebra. Why not put aside ever so much more, so as to let a young boy get quickly to the solution of partial differential equations and other useful parts of mathematics that only a few men now ever reach? I have no right to dictate in these matters to the pure mathematicians. They may see more clearly than I do the necessity of a great mathematician going through the whole grind in the orthodox way; but, if so, I hardly see their position in regard to arithmetic and other things in the study of which they do allow skipping. I should have thought that the advantage of knowing how to use spherical harmonics or Bessel functions at the age of seventeen, so as to be able to start in mathematics at Cambridge just about the place where some of the best mathematical men now end their studies forever, of starting at this high level with youthful enthusiasm, and individuality, and inventiveness, would more than compensate for the evils of skipping."

The first part of the syllabus, and the only part we shall take up, is entitled "A Course of Elementary Mathematics. A course of study recommended for training colleges and for boys and girls."

"*Arithmetic.*—Decimals to be used from the beginning; the fallacy of retaining more figures than are justifiable in calculations involving numbers which represent observed or measured quantities. Contracted and approximate methods of multiplying and dividing numbers whereby all unnecessary figures may be omitted. Using rough checks in arithmetical

work, especially with regard to the position of the decimal point.

The use of 5.204×10^5 for 520400, and of 5.204×10^{-3} for .005204. The meaning of a common logarithm; the use of logarithms in making calculations involving multiplication, division, involution and evolution; calculation of numerical values from all sorts of formulæ however complex.

The principle underlying the construction and method of using a common slide rule; the use of a slide rule in making calculations. Conversion of common logarithms into Napierian logarithms. The calculation of square roots by the ordinary arithmetical method. Using algebraic formulæ in working questions in ratio and variation. Simplification of fractions. Calculation of percentages, etc.

Algebra.—To understand any formula so as to be able to use it if numerical values are given for the various quantities. Rules of indices. Being told in words how to deal arithmetically with a quantity, to be able to state the matter algebraically. . . . Problems leading to easy equations in one or two unknowns. Easy transformations and simplifications of formulæ, and in easy cases finding any one of several quantities in a formula when the others are given. . . . The determination of the numerical values of constants in equations of known form when particular values of the variables are given. The meaning of the expression 'A varies as B.' Factors of such expressions as x^2-a^2, $x^2-11x+30$, $x^2-5x-66$."

From the paragraph on mensuration I can quote only a few statements, showing how Professor Perry would use experimental methods to test the accuracy of rules. Thus, "Testing experimentally the rule for the length of the circumference by using strings round cylinders, or by rolling a disc or sphere. Inventing methods of measuring the lengths of curves. Testing rules for the areas of a triangle, parallelogram, etc., by use of scales and squared paper." The determination of the areas of irregular plane figures by five different methods, including the use of Simpson's rule and the planimeter. . . . "Rules for volumes of prisms, cylinders, cones, spheres and rings, verified by actual experiment; for example, by filling vessels with water or by weighing objects of these shapes made of material of known density, or by allowing such objects to cause water to overflow from a vessel. . . . Stating a mensuration rule as an algebraic formula, etc."

"*Use of Squared Paper.*—The use of squared paper by merchants and others to show at a glance the rise and fall of prices, of temperature, of the tide, etc. The use of squared paper should be illustrated by the working of many kinds of exercises, but it should be pointed out that there is a general idea underlying them all." Among others he mentions such as the following: "Plotting of statistics of any kind whatsoever, of general or special interest. What such curves teach. Rates of increase.

Interpolation. . . . Probable errors of observation. The calculatation of a table of logarithms. Finding an average value. The method of fixing the position of a point in a plane. Plotting of functions, such as $y=ax^n$, $y=ae^{bx}$, for various values of a, b, and n. The straight line, meaning of its slope, slope of a curve at any point in it.

Determination of maximum and minimum values. The solution of equations."

"*Geometry.*—Dividing lines into parts in given proportions, and other experimental illustrations of the sixth book of Euclid. Measurements of angles in degrees and radians. The definitions of the sine, cosine and tan-

gent of an angle; determination of their values by graphical methods; setting out of angles by means of a protractor when they are given in degrees or radians, also when the value of the sine, cosine or tangent is given. Use of tables of sines, cosines and tangents. The solution of a right-angled triangle by calculation and by drawing to scale. The construction of a triangle from any given data; determination of the area of a triangle. The more important propositions of Euclid may be illustrated by actual drawing; if the proposition is about angles, these may be measured by means of a protractor; or if it refers to the equality of lines, areas or ratios, lengths may be measured by a scale, and the necessary calculations made arithmetically. This combination of drawing and arithmetical calculation may be freely used to illustrate the truth of a proposition. A good teacher will occasionally introduce demonstrative proof as well as mere measurement." Then follow some elementary uses of analytic geometry of space and descriptive geometry.

In the very interesting discussion which followed the reading of the paper and the presentation of the syllabus decided objection was made to the strongly utilitarian tendency of a large part of Professor Perry's remarks. Professor Forsyth, in particular, said: "I must point out what would be a platitude if we were not in discussion, that scientific subjects do not progress necessarily on the lines of direct usefulness. Very many of the applications of the theories of pure mathematics have come many years, sometimes centuries, after the actual discoveries themselves. The weapons were at hand, but the men were not ready to use them. Take the case of medicine, which surely is a practical subject. It owes immense debts to the study of sciences like physiology and bacteriology; yet these have been developed and continue to be developed, along their own lines, without being guided in the direction of immediate application at every turn. Yet independent as has been their development. it is notorious that, perhaps all the more because of their freedom in growth, they have provided new knowledge that is of the utmost importance in the conduct of living processes. Take one last example, the X rays. If any one had been set down, as a practical problem, to take a photograph through solid things, I think the common answer would have been that he was being told to solve an insoluble problem. Yet its solution came from the physicists, indirectly as it were, in the course of researches made to obtain knowledge for its own sake. The knowledge so obtained has subsequently led to wonderful results in its application. Influenced by these examples and by others more directly mathematical upon which I shall not enter, I must decline to accept utility as the main or the sole discriminating test, either in the study or the teaching of mathematics."

Had I the time I should like to quote from the remarks of several of the other participants, but I shall have to content myself with a few selections.

Lord Kelvin wrote: "I am overdone with work which must not be postponed, and I am sorry therefore not to be able to write anything on the subject. I think your syllabus was good indeed. It is very like the teaching I had from my father."

Sir John Gorst, chairman of the joint session, told a unique experience he had in New Zealand in his younger days. He said: "I taught, or attempted to teach, mathematics to the Maori boys and men. As far as the teaching of arithmetic went I taught on a sort of embryo Sonnenschein

principle, and I found them remarkably apt and quick pupils. They learned the practical arithmetic, which was useful to them in actual life, and they learned it with extraordinary rapidity—far faster than boys or men would generally learn it in this country. But when in my youthful enthusiasm I proceeded to try to teach some of them Euclid, or rather geometry after the Euclid fashion, I absolutely and entirely failed. There was not one of them that could grasp or understand the simplest of the propositions of Euclid. . . Had I had the advantage of the discussion to which I have listened to-day, I should have abandoned teaching in the ordinary way until they had been familiarized with angles, lines, areas, and geometrical figures, of which the Maori youth was absolutely ignorant. I suppose by a method of that kind even the least developed intellect of the uncivilized native of New Zealand might have been brought to take in some of the very simple propositions of geometry."

Professor Everett said: "The teaching of geometry has been too prosaic. The minds of boys and girls are not ripe for dealing with abstractions. The way in which Euclid begins (especially if the whole body of definitions is taken first) gives the learner the impression of a castle in the clouds.

A moderate amount of practical geometry should come first, including methods of bisecting angles and lines, drawing lines at right angles, making a triangle with sides of prescribed lengths, and inscribing a regular hexagon in a given circle. This will give the learner definite conceptions, and help him to feel that he is on solid ground.

Side by side with Euclid, or a substitute for Euclid, verification by actual measurement of carefully drawn figures should be encouraged. It is useful as a test of the accuracy with which measurements can be made by the methods employed, and also useful as a check against mistakes—which are liable to be made in abstract reasoning as well as in other matters. One of the most important habits in scientific investigation of all kinds is the habit of testing the correctness of one's conclusions by independent methods; and this habit should be inculcated by assiduous practice, as an important element in personal character—an element inseparably associated with the honest pursuit of truth. . . .

The learner should be taken on, as quickly as is consistent with intelligent progress, to the higher branches of mathematics. . . .

The elementary conceptions of the infinitesimal calculus and its simpler processes, should be introduced at an early stage in mathematical teaching.

Another subject that is too long postponed is solid geometry. It is postponed so long that most boys do not get it at all. Considering that we live and move in space of three dimensions, it is unreasonable and impractical to confine all accurate thinking and teaching for three or four years to two-dimensional space. The result is to produce an instinctive shrinking from three-dimensional thinking, as if it involved some terrible mystery." I wonder what Professor Everett would think of the method now coming into vogue in Italy of teaching plane and solid geometry together from the beginning! Professor Everett's remarks are so good throughout that I should like to quote further, but time will not permit. I will hasten on to Professor Perry's summing up of the discussion. He says: "We who have taken part in this discussion have been criticized by some educationists because we have only been expressing well-known educational truths. They forget that, however well-known these truths

may be, they have never yet—never till now—been expressed publicly by more than two or three mathematical teachers. They forget that a reform in the teaching of mathematics was absolutely impossible without the consent and advice of the mathematicians.

It will be found that my syllabus contains almost all the new suggestions which were made by speakers who had no time to study it. (1) Experimental geometry to precede demonstrative. (2) Some deductive reasoning to accompany experimental geometry. (3) Mathematics to enter into the experimental science syllabus as much as possible. (4) Rough guessing at lengths, weights, etc., to be encouraged. (5) Recognition of the incompleteness of any external examination. (6) The importance of familiarizing a boy with problems in three-dimensional space. (7) A hard and fast syllabus undesirable; even the sequence of subjects to be left to a good teacher's initiative.

Further on Professor Perry rather nonchalantly says: "On the whole, I think it may be said that I am in accord with every one of my critics, but of course I know that they cannot unreservedly agree to the adoption of my syllabus as it stands for every kind of student. At all events it is quite evident that there is unanimity in the desire for an immediate large reform in the teaching of mathematics.

I have long known that there is this unanimity among educationists generally, but it is unexpected to find it among the great mathematicians, and the most important teachers of mathematics. I take it that we are all agreed upon the following points:—

1. Experimental methods in mensuration and geometry ought to precede demonstrative geometry, but even in the earliest stages some deductive reasoning ought to be introduced.

2. The experimental methods adopted may greatly be left to the judgment of the teachers; they may include all those mentioned in the elementary syllabus which I presented.

Some of the things for which I contend were put so prominently forward that, if speakers did not object to them specifically, they may almost be taken as agreed to. They are such things as these that follow. Most of them are agreed to specifically by about half my critics.

3. Decimals ought to be used in arithmetic from the beginning.

4. The numerical evaluation of complex mathematical expressions may be taken up almost as part of arithmetic, or at the beginning of the study of algebra, as it is useful in familiarizing boys with the meaning of mathematical symbols.

5. Logarithms may be used in numerical calculation as soon as a boy knows that $a^n \times a^m = a^{n+m}$, and long before he is able to calculate logarithms. But a boy ought to have a clear notion of what is meant by the logarithm of a number.

6. In mathematical teaching, a thoughtful teacher may be encouraged to distinguish what is essential for education in the sequence which he employs, from what is merely according to arbitrary fashion, and to endeavor to find out what sequence is best, educationally, for the particular kind of boy whom he has to teach.

7. Examination cannot be done away with in England. Great thoughtfulness and experience are necessary qualifications for an external examiner. It ought to be understood that an examination of a good teacher's

pupils by any other examiner than the teacher himself is an imperfect examination.

I have not much doubt as to the unanimity with which everybody may be said to have agreed explicitly or implicitly to all the above statements. About these that follow I am in more doubt. More than half my critics will, I believe, agree to them all for all students. I think that every one of my critics will agree to allow a judicious teacner a free hand, especially when he knows that his pupils are likely to need the use of mathematics in their other studies, and especially if they are likely to become engineers, —i. e., men who apply the principles of natural science in their daily work.

8. A thoughtful teacher ought to know that by the use of squared paper and easy algebra, by illustrations from dynamics and laboratory experiments, it is possible to give to young boys the notions underlying the methods of the Infinitesimal Calculus.

9. A thoughtful teacher may freely use the ideas and symbolism of the calculus in teaching elementary mechanics to students.

10. A thoughtful teacher may allow boys to begin the formal study of the calculus before he has taken advanced algebra or advanced trigonometry, or the formal study of analytical or geometrical conics, and ought to be encouraged to use in this study not merely geometrical illustrations, but illustrations from mechanics and physics, and illustrations from any other quantitative study in which a boy may be engaged."

Since Professor Perry's report was published the discussion has gone merrily on. By invitation of a member of the British Association committee some twenty-two teachers in prominent English public schools sent in a sketch of the changes they would like to see made. In the treatment of geometry they are of opinion:—

"1. That the subject should be made arithmetical and practical by the constant use of instruments for drawing and measuring.

2. That a substantial course of such experimental work should precede any attack upon Euclid's text.

3. That a considerable number of Euclid's propositions should be omitted, and in particular

4. That the second book should be treated slightly and postponed till III, 35 is reached.

5. That Euclid's treatment of proportion is unsuitable for elementary work."

As to arithmetic, they think it "might well be simplified by the abolition of a good many rules which are given in text-books. Elaborate exercises in vulgar fractions are of doubtful utility; the same amount of time given to the use of decimals would be better spent. . . . Four-figure logarithms should be explained and used as soon as possible. It is generally admitted that we have a duty to perform towards the metric system. This is best discharged by providing all boys with a centimeter scale, and giving them continual exercise in verifying geometrical propositions by measurement. . . . Probably it is right to teach square root as an arithmetical rule. . . . Cube root is harder and should be postponed until it can be studied as a particular case of Horner's method of solving equations approximately."

Passing to algebra, we find that a teacher's chief difficulty is in the tendency of his pupils to use their symbols in a mechanical and unintelligent way. . . . Elementary work in algebra should be made as far as

possible arithmetical. . . . Such an exercise as the plotting of the graph $y=2x-\frac{x^2}{4}$ provides a series of useful arithmetical examples which have the advantage of being connected together in an interesting way. . . Subsequently curve tracing gives a valuable interpretation of the solutions of equations. . . . We think that undue weight is often given to such subjects as algebraic fractions and factors. . . Might not the theory of quadratics be deferred till it can be dealt with in connection with that of equations of higher degrees? . . . Indices may be treated very slightly. . . . Our recommendations in algebra are corollaries of two or three simple thoughts; the object in view being,—to discourage mechanical work; the means suggested,—to postpone the more abstract and formal topics, and, broadly speaking, to arithmeticize the whole subject."

They recommend that this be followed by a type of diluted trigonometry in which only the sine, cosine, and tangent shall be introduced with the two identities $sin\Theta^2+cos^2\Theta=1$, $tan\ \Theta=\frac{sin\Theta}{cos\Theta}$, afterward returning to formal algebra for "a revision course bringing in literal equations, irrational equations, and simultaneous quadratics illustrated by graphs, partial fractions, and binomial theorem for positive integral index."

At the annual meeting of the mathematical association held in London, January 18, a paper was presented by Professor A. Lodge on Reform in the Teaching of Mathematics. He spoke principally of the teaching of geometry, and said: "I believe we could not do better at the outset than adopt some French text-book as our model. The Americans have done so already.

The chief points in the French text-books are

1. The more orderly arrangement of propositions.

2. The entire separation of theorems from problems of construction, hypothetical constructions being used in proving a theorem.

3. The closer association of a proposition and its converse when both are true.

4. The adoption of arithmetical notions and algebraic processes

5. The early introduction of simple loci.

6. Insistence on accurate figures drawn by accurate and practical processes.

7 Practice in exercises from the very beginning. Mr. Greenstreet suggests that I should also add:

8. Attention paid to the various phases of a theorem as the figure changes, and (as the student progresses) to the easier forms of generalization.

"The greater part of these improvements could be adopted at once, provided the sanction of the great examining bodies can be obtained." Aye, but there's the rub.

The *School World* for March is a special mathematical number. It contains articles on school mathematics from the university point of view by mathematicians of Oxford, Cambridge and Glasgow, an article on Elementary Trigonometry in Schools, by Professor Mathews; a Review of the British Association Discussion, by Professor Bryan; a paper on the Teaching of Secondary Mathematics, by Professor Minchin; one on the Teaching of Euclid's Elements, by Headmaster Fletcher, together with considerable correspondence. I shall make a few selections from Professor Bryan's review. He says:—

"It may now be taken for granted that some important changes are at the present time desirable in the order of learning mathematics in this country (for I regret to find that so much is being said about teaching and so little about learning), but it is greatly to be feared that, soon after a change has been made, the new system will be found to have its own drawbacks no less than the old. . . .

In the old style of things the use of algebraic symbols was prohibited in examinations in Euclid. Is it not the fact that much greater life and reality can be put into the study of geometry by encouraging instead of excluding the use of algebraic formulæ?"

After giving illustrations he goes on to say:—

"This use of algebra in the study of geometry has the following advantages:—

1. It breaks down the hard and fast line between algebra and geometry.

2. It furnishes the student with a number of easy examples and exercises in geometry. . . .

3. It introduces the beginner in algebra to the use of symbols for representing concrete quantities (lengths, angles, etc.) and to the nature and meaning of an algebraic formula. . . .

. . . Formal blackboard lectures are a very ineffectual means of teaching improved methods to a beginner. Besides being wasteful of time they require him, (i) to listen when the teacher is talking, (ii) to look at the blackboard when he happens not to stand in front of it, (iii) to write down notes of the lectures and (iv) to think of the method of reasoning, all at the same time, and if he fails for a moment to perform simultaneously any one of these four operations he loses the whole thread of the lecture. Hence it is that so many pupils after the most 'thoughtful' lecturing reproduce faulty text-book proofs which they have been warned against by their teachers, but which they can at least 'get up'."

He sums up as follows:—

"The teacher can do very little to reform the teaching of mathematics to large classes of elementary pupils, for, if he departs materially from the methods of the text-books, the learning of mathematics will suffer accordingly.

The text-book writer can do practically nothing to reform the teaching of mathematics, otherwise his books will not sell and other books will be used instead. This is particularly true when faulty methods or inaccurate statements have to be reproduced (as is frequently the case) in order to make a book salable.

The examiner can do much to reform mathematical teaching by modifying the character of his questions so far as this is consistent with his syllabus, and with giving candidates a fair chance of scoring marks.

The governors of educational institutions could greatly reform mathematical teaching by increasing the mathematical teaching staffs and giving mathematics a more prominent place in the curriculum. This must come about sooner or later, and the sooner the better.

There is no royal road to teaching mathematics, for it is impossible for a boy of given capacity to learn more than a certain amount in a certain time, the rate of learning varying with the individual, from zero upwards, and if it be attempted to introduce new ideas too rapidly into the course the result must be a hopeless failure."

The frank confessions and the suggestions for improvement—which we

must assume to be equally honest—found in these discussions throw an unmistakable flood of light upon the mathematical situation in the public schools of England. Held in servitude by the boards of examiners, who will not permit a hair's breadth variation from the order of Euclid's elements, and required to submit to external examinations which serve principally to reveal the malevolent ingenuity of framers of impractical problems, both teachers and pupils groan under a worse than Egyptian bondage. Small wonder that elementary mathematical teaching in England has fallen so far below that of France, Germany, Italy or America!

The probable outcome of this discussion is hard to forecast. That the committee will recommend some substantial changes for the better may reasonably be expected. That it will advise the rejection of Euclid as a text-book is by no means certain, though it would seem as if nothing pedagogically worse than the present teaching of Euclid, without any knowledge of concrete geometry, or any use of rule, compasses, and protractor, could easily be devised.

The process of change, even when once begun, will need at least a generation. Boards of examiners must "put away the evils of their doing from before all eyes and learn to do well."

Teachers will have to be trained by some other method than merely putting new wine into old bottles, and possibly the author in his anguish will be compelled to say, "Oh, that mine adversary had written a book!"

Methods of Attack in Geometry

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Geometry has long been looked upon as furnishing a peculiar and distinct kind of mental discipline. Plato inscribed above the entrance to his school, "Let no one unacquainted with geometry enter here." Today if we are asked why the subject is taught in our high schools we say that aside from the fact that a certain knowledge of geometry, as that concerning areas and volumes, is useful and should be known, it is given largely because it furnishes almost the only examples of pure logic in the high school course, that it teaches the student to consider carefully given data, and to reason from this to accurate conclusions; yet whether the student can do this or not depends largely upon how the subject is taught. If a student of geometry be given an exercise that does not involve familiar figures and theorems, although it may be a theorem in some other branch of mathematics, he is usually helpless in discovering a key to the proof. This shows us how much of what we thought in the geometry class was the result of reason must have been the result of a good memory. Suppose he is given the theorem that "all prime numbers are either of the form $6n+1$ or $6n-1$." If he gets a proof at all, there is generally a lack of definite, systematic method of attacking it, and one is convinced that he is *not* being taught "to consider carefully given data and reason from this to accurate conclusions" to the extent that we might expect. I find that only a small per cent of those who come to us—a great many of whom are from the smaller high schools perhaps—are able to attack with any degree of elegance or satisfaction such theorems as the above.

Geometry can certainly be so taught as to secure to a very satisfactory degree the desired culture value spoken of above, but I fear that too often we are satisfied if the student of geometry can reproduce the book on the blackboard or on paper and possibly be able to justify each statement of the text by citing some previously studied proposition, axiom, or definition. The statement that one often hears in a geometry class that "I can't remember how it begins," "I forget the next step," or "I don't remember the proposition but I know how to prove it," leads me to believe that with far too many pupils and in too many class rooms the subject is more a drill in memory than an exercise in logic. Granting, however, that the student does see every step in the proof, and sees in the proof an example of logical deductive reasoning, the method of proof in our texts is necessarily synthetic, with no hint as to how the proof was discovered or what suggested the theorem; hence the study of the demonstrated theorems cannot of itself give the student the power to solve or prove the various propositions that will present themselves in other subjects. To get the greatest educational good from the subject the student must not be hurried through the course, learning simply the proofs of the text, but must supplement this by a great deal of original work in various demonstrations and solutions.

Happily the exercises (usually called originals in this country and riders in England) cannot be grouped into cases, and methods, rules, or principles given that enable us to solve all of each case as we used to do in our older arithmetics when we came to the subject of percentage, yet there are certain principles or methods of attack that make the study of an exercise systematic or scientific in the fullest measure, and unless the student is taught to study exercises in this systematic way—unless he is taught to study the exercises from the standpoint of analysis and thus discover the possible lines of procedure in attacking the demonstration—he is not gaining the power that is going to help him to study the larger problems of life. The student of geometry, when given an exercise, should no more fold his arms and try to recall "some proposition like it," or look through his or other texts for a proof than a student of botany or chemistry should determine a plant or find the ingredients of a compound by finding in his encyclopedia something that looks like it. He ought to have a definite line of procedure and be able when a proposition is proposed to do something if it is nothing but to waste paper, just as the student of chemistry would do something if nothing but have an explosion.

While but few rules can be laid down, these few give system to our work. Let us notice the general lines of procedure.

1. First, *assume that the theorem is true and draw an accurate figure*, and the accurately drawn figure will often suggest a proof; for example, certain triangles may appear to be congruent; if they are this will lead to some other relations that make the proof evident, hence we seek to prove these triangles congruent.

By assuming the theorem to be true is meant, that, if for example, certain lines or angles are to be proven equal they are to be drawn so; and drawing an accurate figure means not only that if lines are equal, parallel or perpendicular, they must be drawn so, but also that lines are *not* to be drawn equal, parallel or perpendicular unless they are given so. A triangle is not to be drawn with two sides equal unless the theorem calls for an isosceles triangle, nor a quadrilateral drawn with any two sides equal or parallel unless the exercise calls for a special quadrilateral of this kind.

An inaccurate figure may seem to show relations that do not exist, as in the examples given in "Ball's Mathematical Recreations" where all triangles are proven to be isosceles or a right angle equal to an obtuse.

2. After the figure has been drawn *get clearly in mind just what is given in the figure and just what is to be proven*, i. e., the *data* and the *conclusion*. It is also very important that *the student know the definition of all terms in the theorem*, and instead of the *hypothesis* and *conclusion* of the theorem it will be well to use Pascal's advice and "substitute the definition for the name of the thing defined" and thus get a *new hypothesis* and *a new conclusion*.

3. Next, *recall all the propositions that can have a bearing upon the exercise under consideration*. I believe that a large part of the difficulty that a beginning student has, comes from his not having clearly in mind all these fundamental facts that he needs. For example, if lines are to be proven equal, he must know all the propositions that refer to equal lines, such as congruent triangles, opposite sides of a parallelogram, etc. This in turn necessitates his knowing all the theorems concerning triangles, parallelograms, etc , and proving the triangles congruent will necessitate his proving angles equal, and this likewise requires the theorems concerning equal angles. Now, to get these fundamental facts fixed, I should require the student, at first, to recall with each exercise *all* the propositions that might possibly suggest a proof.

He is now ready after following each suggestion to its limit, to select those which it is *possible* to use as well as those which it is *best* to use. When he has done this for some time, until he has "at his tongue's end" all propositions and corollaries that he has proven, he sees in each of the terms involved in a theorem, not only the *one* definition of the term but *many*, and is able to select the particular ones that will lead to a proof. For example, he comes to think of parallel lines not only as those that do not meet but also as those that make with a transversal equal alternate interior angles, equal corresponding angles, or the two interior angles on the same side of the transversal supplementary. He thinks of a parallelogram not only as a quadrilateral whose opposite sides are parallel but also as a quadrilateral whose opposite sides are equal, two of whose sides are equal and parallel, whose diagonals bisect each other, etc. He is now in a fair way not only *to succeed*, but *to enjoy* the subject and get from it very helpful discipline.

4. But there is another very important feature that we have not mentioned, i. e., having recalled all propositions that can possibly relate to the thing to be proven, certain ones may be seen to apply, while again none of these may come directly under the figure as it is given: hence now, and not until now, is the student ready to draw, and draw intelligently, the auxiliary lines needed to make some of these theorems apply.

5. Now supposing that we have discovered theorems that may be made to apply, or by drawing auxiliary lines they may be made to do so; we reverse the steps of the analysis and give the regular synthetic proof.

6. After carefully analyzing the figure as suggested above, it no direct proof can readily be discovered, then *assume the theorem false* and by analysis prove that the assumption leads to an absurdity. This method is called the *indirect method* or *reductio ad absurdum*. As an example: *two*

triangles are congruent when the three sides of the one are equal respectively to the three sides of the other.

In the other two cases of congruent triangles that the texts generally give before this one is taken up the triangles have angles in each equal, so that when certain sides are made to coincide it is known where the other sides *must* fall. In this case, however, since nothing is known of the angles, we do not know, when two equal sides are made to coincide, where the other sides are going to fall, hence we may assume that they do *not* coincide, but fall as in the figure below, and prove the assumption absurd.

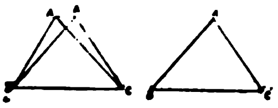


Fig. 1.

Proof.
1. Place △ A'B'C' upon △ ABC so that B'C' will coincide with BC and suppose that A' does not fall upon A.
2. ∵ A'B' = AB and A'C' = AC, ∴ triangles A'BA and A'CA are isosceles.
3. ∴ the perpendicular bisector of A' A will pass through B and C which is absurd.
4. ∴ the assumption that A' does not fall upon A is absurd and the triangles must coincide throughout, and hence are congruent.

To illustrate the steps spoken of above in a single exercise, suppose we have the theorem that, *if the diagonals of a trapezoid are equal the trapezoid is isosceles.*

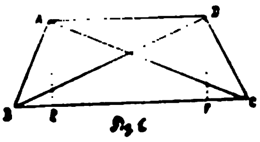


Fig. 2

1. ∵ the trapezoid is to be proved isosceles it should be drawn so.
2. *Given* the trapezoid ABCD with AC = BD.
3. *To prove* that ABCD is isosceles. Now, use Pascal's advice and "substitute the definition in the place of the name of the thing defined" and say, *to prove* AB = DC.
4. *Analysis.* To prove lines equal requires,
   1. congruent triangles,
   2. parallelograms, etc.

   (a) To prove the triangles congruent requires that we have
   1. The three sides of one equal, respectively, to the three sides of the other,
   2. two angles and a side of one equal, respectively, to two angles and a side of the other, or
   3. an angle and two sides of one equal, respectively, to an angle and two sides of the other, (except in the ambiguous case).

   Again, to prove the angles equal requires,
   1. congruent triangles,
   2. vertical angles,
   3. parallel lines.

   (b) To prove a figure a parallelogram requires
   1. opposite sides parallel,
   2. a pair of opposite sides parallel and equal,
   3. opposite angles equal, etc.

Now, observing our figure, we see that none of these can be proven as the figure stands; we see therefore the need of other lines and seek to draw some line that will give a figure or figures that will enable us to use some

of the theorems recalled. Suppose our proof is to be that of congruent triangles. To get the necessary data in order to prove triangle ABC congruent to triangle BCD we must have in addition to what we already have, angle ACB equal to angle CBD; hence we form congruent triangles involving angles ACB and CBD. To do this we know that two right angles are congruent when the hypotenuse and a leg of one equals the hypotenuse and a leg of the other, and, that parallels intercepted between parallels are equal, and, that perpendiculars to the same line are parallel; hence we drop from A and D perpendiculars to BC and prove triangles AEC and BFD congruent. Now we have angle BCA equal to angle CBD and can prove triangles ABC and BCD congruent and hence the proposition.

Or the analysis might take the following form, called *successive substitution*, as given in *Beman & Smith*.

1. I can prove AB=DC if I can prove triangles BCD and ABC congruent.
2. I can prove these triangles congruent if I can prove angles CBD and ACB equal for BD=AC and BC is common to both.
3. But from the given figure I *can not* prove these angles equal; hence drawing auxiliary lines and proving these angles equal I can reverse the process and give the synthetic proof.

Summarizing the steps taken in dealing with theorems we may say:

1. Assume the theorem true and draw an accurate figure.
2. Get clearly in mind the hypothesis and the conclusion, being sure to understand the full meaning of all terms involved, substituting when necessary "the definition in place of the name of the thing defined."
3. Recall all theorems or definitions that refer to the point to be proven.
4. If none of these seem to apply to the figure as it stands, try to draw auxiliary lines that will involve the thing wanted and that will also give a figure to which some of the known theorems will apply.
5. If successful, then reverse the process and give the regular synthetic proof.
6. But if a *direct proof* is difficult to find, then *assume the theorem false* and show that the assumption leads to an absurdity. It might also be well to call attention to the fact that a *converse* proposition is generally more easily proven by this the *indirect method.*

The solution of a problem is approached in a little different manner from the demonstration of a theorem: and the investigation of problems, together with the discussion of the number of solutions in general, and of the relations existing in the data that give a definite number of solutions, and an indefinite number, and also that make the solution impossible, will supplement the discipline obtained from the demonstrations of theorems and give that desired discipline that will better prepare one to solve the various problems that may arise in other subjects. Edwards in his geometry says: "The manner of approaching the solution of any problem is the same in all subjects, i. e., we are to approach it through analysis."

1. In seeking a key to the solution of a geometric problem, in order to aid the analysis, it is generally best to assume the solution performed and from the elements of the figure, recall some known relations that have already been proven. Having discovered enough of these relations make the construction depend upon them.
2. In beginning the study of these problems already solved in the

texts, the student should be made to know at once that *all* solutions *must* depend upon some known theorem or theorems which should be recalled. I should have the student recall other theorems, if such exist, that might suggest a solution other than the one given in the text The student must see not only that to solve a problem he must be able to recall some known proposition that makes the construction evident, but he must see also that all problems must be reduced to one or both of the fundamental problems, *to draw a straight line between two points* or to *describe a circle of a given radius about a given point as center*, and also that the required points are found by the intersection of two lines, straight or curved; hence that almost every solution must depend upon *the intersection of certain loci.*

3. The simplest and most common problems that we have in elementary geometry are those in which the analysis leads to the discovery that the points wanted are on certain loci, hence at their intersection. This method is called the *intersection of loci.* As an example, *to describe a circle of given radius to pass through a given point and cut off equal segments from two parallel lines.* Now this depends upon finding the center of the circle. The analysis leads to the discovery that the center of this required circle is the intersection of the locus o points equidistant from two parallel lines, and of the locus of all points equidistant from a given point, which is a straight line and a circumference. Since a straight line will cut a circumference in two points two solutions in general are possible.

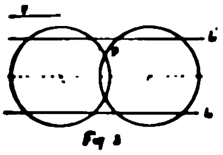


Fig 1

The method of *intersection of loci* is used to such an extent in constructive geometry that the student ought to be made familiar with the most common theorems of loci, and have them fresh in mind when taking up this subject.

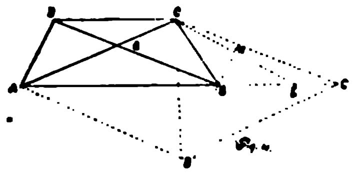
While I am aware that most students go through some sort of analysis without perhaps even being conscious of it, I am sure that the most good will come from the course if the student is made to realize that there is a systematic analysis involved in every discovery of a solution, and if he is required to begin all solutions either written or oral by giving the analysis that led him to see the solution.

4. It will often occur that the analysis of the figure will not reveal any known relations that will give the means of determining the required points without drawing auxiliary lines that will transform the given figure into a a new one which will involve certain elements of the old, just as was done in the case of theorems. This might be called the *method of transformation.* Just as the most difficult theorems were those that had to be transformed by auxiliary lines, so will this class of problems give the most trouble, and the skill in being able to see the needed auxiliary lines will largely determine a student's success with exercises of this sort.

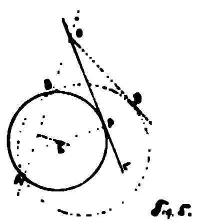
As an example, suppose we are *to construct a triangle having given two sides and the median to the third.* Now the figure with the median drawn seems to give no way of finding the two remaining vertices when one is fixed but if the median be continued its own length and the extremity joined to the extremities of the base the problem is seen to reduce itself to constructing a triangle when three sides are known.

5. The auxiliary lines needed to transform the figure into a new one, however, are usually drawn parallel to lines in the original figure, i. e., certain lines are considered to be moved parallel to themselves, called

translated, thus giving a new figure which involves elements of the old and which makes the solution evident. Such a method of solution is called the *method of parallel translation*. As an example, *suppose we are to construct a trapezoid having given the diagonals, the angle made by them, and the sum of two adjacent sides*. Assuming the problem solved and the trapezoid to be ABCD, we can get no relations from the figure as it stands to tell us where to intersect the diagonals or where to draw a side if a diagonal is fixed; hence we must transform the figure by auxiliary lines. Drawing through A, AB′ parallel and equal to DB, and through B′, B′C′ parallel and equal to AC, it can be proven that the side AB of the trapezoid coincides with the diagonal of the parallelogram thus formed, and the solution becomes evident.



6. While nearly all problems are finally solved by the first method given, i. e., by the method of *intersection of loci*, still it often occurs that before one finds the required loci a difficult analysis has to be performed and then the method of attack is called simply the *method of analysis*, which in reality is the fundamental method involved in the search for a key to the solution of any problem. The problem *to draw a circle whose circumference shall pass through two given points and also be tangent to a given straight line*, is an example of this kind. Suppose A and B to be the given points and L the given line. Now if A and B be joined and this line extended to meet L in O, it is known that the square of the segment on L from O to the point of tangency of the required circle is equal the product of the segments OA and OB; but it is known that this is also true of the length of the tangent from O to any circle through A and B, hence one has simply to describe any circle through A and B and draw from O a tangent OD to this circle, and then OP on L and equal to OD will give the point of tangency P on the given line and the center of the required circle is easily determined.



Since no two problems are solved alike the power to successfully attack an exercise comes from a great deal of practice, coupled with a close observation of the method by which each exercise was studied, rather than from the study of the few methods given above, but I believe that a student has had his attention called to these general methods he will become much stronger and much more interested in his work and gain to a larger degree the strength to handle the problems of any other department.

Simplicity and Exactness in Geometrical Constructions

EDWARD B. ESCOTT, INSTRUCTOR IN MATHEMATICS, UNIVERSITY OF MICHIGAN

It seems quite remarkable that the systematic study of the questions of simplicity and exactness in problems of geometrical construction has been undertaken only within the last fourteen years. In 1888 M. Emile

Lemoine presented to the meeting of the French Association for the Advancement of Science some general considerations on simplicity in geometrical constructions, and since then he has systematized and completed the theory.

A general exposition of the subject may be found in a book which has just appeared:—

E. LEMOINE. *Geometrographie ou art des Constructions geometriques*, published by C. Naud, Paris.

An article by M. LEMOINE, "*Principles de la Geometrografie ou art des constructions geometriques*, appeared in GRUNERT'S *Archiv der Mathematik und Physik*, in 1901, and a slight sketch of the method in the *Bulletin of the American Mathematical Society*, January, 1902, p. 137. There is a note on the subject in the last edition of *Rouche et de Comberousse's Traite de Geometrie Elementaire.*

By the "geometrographic" construction of a problem, is meant that construction of which the coefficient of simplicity, which will be defined later, is the smallest. It ceases to be geometrographic if a construction is discovered which is still simpler, and this becomes then the geometrographic construction. In order to render the constructions comparable we shall suppose — without particular notice to the contrary — that we may use only a single compass; that there is on the drawing at the beginning only the given magnitudes; that we do not execute on the given magnitudes the definitive drawing unless it is specified by the question:

Geometrography has four aims:

1. It gives for a construction a symbol which is a kind of measure of its simplicity and of its exactness.

2. It leads to processes which enable us to effect, in the simplest manner possible, a construction deduced from a geometric solution.

3. It studies and discusses a construction of which the principle is indicated, to substitute for it in some cases a construction which may differ entirely from the first one.

4. It permits us to compare all the constructions which are known of the same problem and to choose the geometrographic construction.

NOTATION

A (r) or A (MN) denotes a circumference of center A and radius r or MN.

We assume that all lines drawn are indefinite in extent.

To place the edge of the rule on a point is called the operation R_1 or Op. (R_1). Then to place the edge of the rule on two given points is Op. ($2R_1$).

To draw a line along the edge of the rule is Op. (R_2).

To put either point of the compass on a given point is Op. (C_1); then to take between the arms of the compass the distance between two points is Op. ($2C_1$). To put a point of the compass on an undetermined point of a line which is drawn is Op. (C_2).

To draw a circle is Op. (C_3).

Every construction may then be expressed finally by the symbol Op. ($l_1 R_1 + l_2 R_2 + m_1 C_1 + m_2 C_2 + m_3 C_3$), l_1, l_2, m_1, m_2, m_3, being integers. $l_1 + l_2 + m_1 + m_2 + m_3$ will be called the *coefficient of simplicity;* or the *simplicity;* $l_1 + m_1 + m_2$, which corresponds to the operations of preparation, will be called the *coefficient of exactness* or the *exactness;* l_2 and m_3 are

respectively the number of straight lines and the number of circles drawn.

FUNDAMENTAL CONSTRUCTIONS

To draw a line,

1. at will, Op. (R_2).
2. through a given point, Op. (R_1+R_2).
3. through two given points, (Op. ($2R_1+R_2$).

To take a given length in the compass, Op. ($2C_1$).

To draw a circle,

1. at will, Op. (C_3).
2. with an indefinite radius but with a given center, Op. (C_1+C_3),
3. with a given center and which passes through a given point, Op. ($2C_1+C_3$)
4. with an indefinite center but with a given radius, Op. ($2C_1+C_3$).
5. with the radius a given length and the center a fixed point, Op. ($3C_1+C_3$)

To lay off on a line which is drawn a length from an undetermined point of this line, or starting from a point on this line, the length comprised between the arms of the compass. Op. (C_2+C_3), or Op. (C_1+C_3).

ELEMENTARY CLASSICAL PROBLEMS

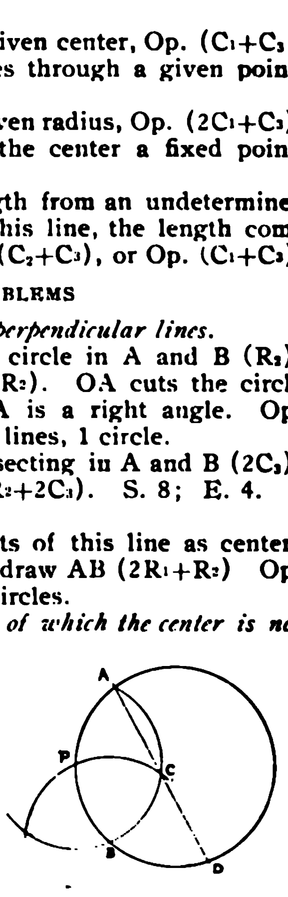
I. To construct a right angle, or to draw two perpendicular lines.

(a) Draw a circle (C_3); a line cutting the circle in A and B (R_2). Connect A and the center O of the circle ($2R_1+R_2$). OA cuts the circle again in C. Draw CB ($2R_1+R_2$); the angle CBA is a right angle. Op. ($4R_1+3R_2+C_3$). Simplicity 8. Exactness 4. 3 lines, 1 circle.

(b) Draw any two circles O(r), O′(r), intersecting in A and B ($2C_3$). Draw AB and OO′ ($4R_1+2R_2$). Op. ($4R_1+2R_2+2C_3$). S. 8; E. 4. 2 lines, 2 circles.

(c) Draw a line (R_2); with any two points of this line as centers draw circles ($2C_2+2C_3$) intersecting in A and B; draw AB ($2R_1+R_2$) Op. ($2R_1+2R_2+2C_2+2C_3$). S. 8; E. 4. 2 lines, 2 circles.

II. To find the length of the radius of a circle of which the center is not given.

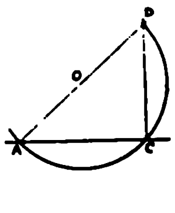


P being an arbitrary point on the circle, draw any circle P(r), (C_2+C_3) which cuts the given circle in A and B. Draw B(r) (C_1+C_3) which cuts P(r) in two points. Join either one of them, say C, to A ($2R_1+R_2$) AC cuts the given circle in D. DC is the length of the radius.

Op. ($2R_1+R_2+C_1+C_2+2C_3$) S. 7; E. 4. 1 line, 2 circles.

III. At a point C on a given line AB, to erect a perpendicular to this line.

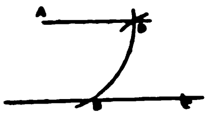
(a) The classical construction has for its symbol Op.($2R_1+R_2+3C_1+3C_3$). S. 9; E. 5. 1 line, 3 circles.



(b) Geometrographic construction. Place one point of the compass in an arbitrary point O, place the other on C (C_1), draw O (OC) (C_3) which cuts CA in A. Draw AO ($2R_1+R_2$) cutting O (OC) in D; draw DC, ($2R_1+R_2$). Op. ($4R_1+2R_2+C_1+C_3$) S. 8; E. 5. 2 lines, 1 circle.

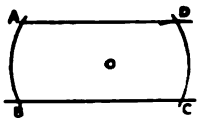
IV. Through a point A to draw a parallel to the line BC. (a) and (b) the two constructions commonly given have the following symbols, Op. $(2R_1+R_2+5C_1+3C_3)$. S. 11; E. 7. 1 line, 3 circles.

Op. $(3R_1+2R_2+5C_1+3C_3)$. S. 13; E. 8. 2 lines, 3 circles.



(c) Draw A (r) giving B, then B (r) giving C $(2C_1+2C_3)$. Draw C (r) which cuts A (r) in D (C_1+C_3). Draw AD $(2R_1+R_2)$.

Op. $(2R_1+R_2+3C_1+3C_3)$. S. 9: E. 5. 1 line, 3 circles.

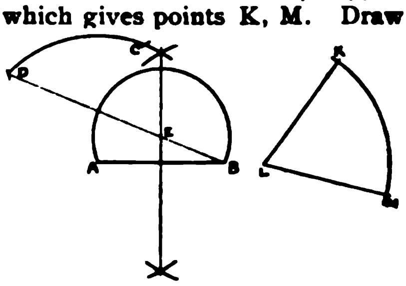


(d) Draw a circle O (OA) (C_1+C_3) which gives B and C. Take AB in the compass $(2C_1)$, draw C (AB) (C_1+C_3) which places D on O (OA) on the same side of BC as A. Draw AD $(2R_1+R_2)$. Op. $(2R_1+R_2+4C_1+2C_3)$. S. 9; E. 6. 1 line, 2 circles.

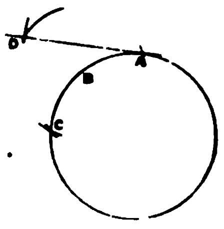
V. On a given line as chord, to describe a segment of a circle containing a given angle LMN.

(a) Classical construction. Draw BD making with AB an angle equal to LMN; draw the perpendicular bisector of AB and the perpendicular at B to BD, these two perpendiculars intersecting in O; draw O (OA). Op. $(6R_1+3R_2+11C_1+8C_3)$. S. 28; E. 17. 3 lines, 8 circles. In conducting the operations with economy we may reduce the symbol by (C_1+C_3).

(b) Geometrographic construction. Draw the circles A (AB), B (AB) $(3C_1+2C_3)$, then L (AB) (C_1+C_3) which gives points K, M. Draw B (KM) cutting A (AB) in C, and C (KM) cutting same circle in D, $(4C_1+2C_3)$. Draw the perpendicular bisector of AB $(2R_1+R_2)$, and BD $(2R_1+R_2)$ intersecting in E; finally draw E (EA) $(2C_1+C_3)$ which gives the segment required. Op. $(4R_1+2R_2+10C_1+6C_3)$. S. 22. E. 14. 2 lines, 6 circles.



VI. To draw a tangent to a circle of center O, at a point A on the circle.



(a) The common construction is to erect a perpendicular to the radius at its extremity. Op. $(6R_1+3R_2+C_1+C_3)$. S. 11; E. 7. 3 lines, 1 circle.

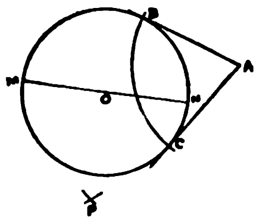
(b) Geometrographic construction. B being any point of the given circle, draw B(BA) $(2C_1+C_3)$ which cuts it again in C; draw A (AC) $(2C_1+C_3)$ which cuts B (BA) in D. Draw DA the required tangent $(2R_1+R_2)$.

Op. $(2R_1+R_2+4C_1+2C_3)$. S. 9; E. 6. 1 line, 2 circles.

VII. From a point A outside a circle of center O, to draw a tangent to the circle.

(a) Classical construction. Draw OA; describe the circumference which has OA for diameter and cuts the circumference in B and C, the

points of tangency. Draw AB and AC. Op. $(8R_1+4R_2+4C_1+3C_3)$. S. 19; E. 12. 4 lines, 3 circles.

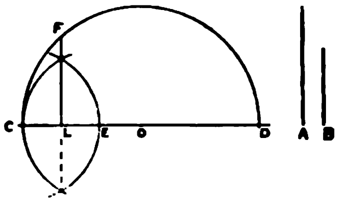


(b) Geometrographic construction. Draw any diameter MN (R_1+R_2); draw M (OA), N(OA) $(4C_1+2C_3)$ intersecting in P. Draw A (OP) $(3C_1+C_3)$ which cuts the given circle in B and C, the points of tangency. Draw the tangents AB and AC. $(4R_1+2R_2)$. Op. $(5R_1+3R_2+7C_1+3C_3)$. S. 18; E. 12. 3 lines, 3 circles.

VIII. To construct the mean proportional X between two given lines A and B. $X^2=A\cdot B$. Let A>B.

(a) (b) and (c) the three constructions commonly given; the first two are based on the properties of the segments of the hypotenuse of a right triangle made by the perpendicular from the vertex of the right angle, and the third is based on the property of the tangent to a circle and the segments of the secant drawn through the same external point as the tangent. They give for simplicity and exactness,—

(a) S. 22; E. 14; (b) S. 28; E. 17; (c) S. 30; E.19.



(d) Geometrographic construction. Draw any line (R_2) and with any point of the line O as center, draw O(A), $(2C_1+C_2+C_3)$ which cuts the line in C and D. Draw C (B) $(3C_1+C_3)$ which places E between C and D; draw E (B), (C_1+C_3) and through the intersections of these two circles draw the perpendicular bisector of CE cutting O (A) in F. CF is the mean proportional. Op. $(2R_1+2R_2+6C_1+C_2+3C_3)$ S. 14; E. 9. 2 lines, 3 circles.

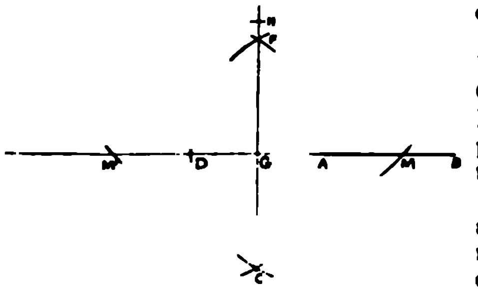
We can prove this by noticing that in the right triangle CFD, $\overline{CF}^2=CL\cdot CD=\frac{B}{2}.2A=A\ B$.

IX. To divide a line AB in extreme and mean ratio.

(a) Classical construction. In making this construction as it is ordinarily done, we have Op. $(6R_1+3R_2+11C_1+9C_3)$. S. 29; E. 17. 3 lines, 9 circles. By geometrographic principles it may be reduced to Op. $(4R_1+2R_2+10C_1+8C_3)$. S. 24; E. 14. 2 lines, 8 circles.

There are a great number of constructions more simple than the classical construction, among them several geometrographic constructions. The following is one of them.

(b) Geometrographic construction. Draw A (AB) $(2C_1+C_3)$, which cuts AB in D; draw D (AB) (C_1+C_3) cutting the first circle in F and C. Draw FC cutting AB in G. Draw G (AB) cutting FC in H. While the point of the compass is at G, take the length GB in the compass (C_1), then draw H (GB) (C_1+C_3) cutting AB in M and M'. M is the point of internal division and M' the point of external division. Op. $(2R_1+R_2+$



$6C_1+4C_3$). S. 13; E. 8. 1 line, 4 circles. The simplification in this case is from 29 to 13.

That which precedes is sufficient to show the application of Geometrography. It is remarkable that it has been possible to simplify all the fundamental constructions, sometimes to a very great extent, as in the construction of a mean proportional from 28 to 14, and in the division of a line in extreme and mean ratio from 29 to 13.

The author, M. Lemoine, has applied geometrographic methods to a considerable number of other problems, and has also modified these constructions by allowing other instruments to be used, in particular the square or right triangle used by draughtsmen.

BIOLOGICAL SECTION

Conference of the Biological Section

Two sessions were held, Friday afternoon and Saturday afternoon, March 28 and 29, the latter being a joint session with the Michigan Academy of Science. Both sessions were well attended.

After calling the meeting to order and making announcements, the chairman, Mr. L. Murbach, made some remarks on the proposed amalgamation of the biological section with the Michigan Academy of Science. He said the biological section would better not surrender its identity by fusion with the Michigan Academy of Science, but that the Michigan Academy of Science might form a science-teaching section which the members of the biological section could join, leaving them the opportunity to hold their own conference at any time when the Michigan Academy of Science meets at a different time or place from the Schoolmasters' Club. He pointed out the advantages of the union as, membership in the larger body, opportunity to hear purely scientific papers, and the right to the publications of the proceedings. Pending the action of the Michigan Academy of Science, the Conference proceeded with its program, electing Dr. F. C. Newcombe, chairman, and Miss Genevieve Derby, secretary.

Papers were presented as follows:

THE RELATION OF NATURE STUDY TO HIGH SCHOOL BIOLOGY

RAY A. RANDALL, ASSISTANT PRINCIPAL, GOSHEN (IND.) HIGH SCHOOL

Never before has the subject of science occupied the prominent place in which it stands now. Never has the progress of civilization been so rapid as the last century, during which time science has done so much for the world. Science is the mother of civilization. This advancement was brought about by the mental operations of observation, experiment, classification, deduction, and generalization.

Today all scientific training, all scientific knowledge must come through these primary conceptions and today these primary conceptions

must come through nature's door as in the past. For the child's nature, dependent upon his inherited impulses, necessitates the exercises of his powers through experiences similar to those which took part in the physical and mental development of his ancestors. The lifeless forms of Latin and Greek are no longer in the path of advancement. We now think in our own language, but the present century has yet to blot out the word or the form idea of the old regime. We think the child has the idea when he has only the form in which it is expressed. The piesent day idea of teaching the child new words by associating the word with the object I believe to be radically wrong in that it makes nature subjective, not objective. The object in the child's hand becomes a part of his experience and that experience expressed will bring the word desired.

Nature study furnishes a basis of reasoning, i. e : from particular to general, which applied to other studies makes real their notions. It puts the child in the right attitude for work, makes him independent in thought and action, and by its reactive influence moulds the character.

Upon recognizing the aim and importance of nature study in the grades we next turn our attention to the presentation of the subject, to the basis for work and the relation of the work to High School Biology. Many attempts to introduce nature study in the grades have failed, and I dare say it is due to a great extent to the method in vogue of leaving the science work to the grade teacher. To teach nature study in the right way a Col. Parker is needed, a person who can lead others to observe and experiment. Time and a great deal of it is needed. Time to locate the proper field of study, time to take the children to the fields, time to prepare and perform experiments, time to look over note-books with the individual. Systematic work is needed, not a heap of experiment without a definite aim in view. Material both for experiment and observation is need d and should be of the proper kind and plenty of it. In most Graded Schools at the present time nature work is taught by the teachers of the respective grades and in most cases, not knowing the subject they are instructed in the work by the superintendent or science teacher. Due to the nature of the case they cannot fulfill the requirement of a nature study teacher. A specialist born a naturalist would satisfy the condition, and since the importance of a right relation of the child to nature cannot be measured in dollars and cents, an argument against the expense due to the employing a special instructor for the town, has no basis. Again if we recognize nature study as being on a par with reading, language, history, etc., it demands a place in the curriculum and should be presented by a teacher whose acquaintance with the subject is as thorough as with other subjects. One instructor could handle from three to five grades giving six hours a week to a grade by devoting three periods of two hours each to each grade, with satisfaction.

In Biology which furnishes a large share of topics for nature work the natural whole may be the single animal or plant or several living objects taken together to form a society for a definite aim or purpose. Such units or wholes as above mentioned form a natural basis for deductive reasoning, comparisons and generalizations. The course of reasoning should be, in general, first, observation of life in the single thing and repeated recognition of the different fundamental laws: second, application of the laws to unfamiliar objects and life societies.

In the selection of topics strict scientific order should not control.

Factors like material of home environment, seasons of the year, corrrelation with subjects like history, literature, and geography, and ability of the child should figure to a great extent in the sequential arrangement of material. The arrangement of material for study should be such that the pupils in the lower grades could do mainly observational and creative work, gathering data and motives for the generalizing and interpreting which should become more and more prominent and which should gradually increase in difficulty during each successive grade. Repetition should be avoided as much as possible by assigning concrete material for each grade. The provision of material should be such as to insure the largest return to the children. For our work we may rely upon material provided spontaneously by nature or upon the creative effort of the child in planting the seed and caring for the plant or in protecting and caring for animal life. In the case of spontaneous provision, the child under proper direction may bring material to the class-room or he may study the object in its natural habitat.

As a preparation for High School Biology the pupil should have a love for and a sympathy with nature, a desire to investigate and the power to generalize and deduce, correct habits, the where, when, and how of finding material, a scientific spirit, proper nomenclature and facts. Of these the fundamental consideration upon which all the others depend is love of nature which constitutes a means to an end and also an end in itself. Nature study does not aim to make specialists but to educate, to make life happiness in the best sense of the term. Hence the necessity of a sympathetic relation, for to be in touch with nature is to live to enjoy happiness. A desire to investigate would follow in most cases from a sympathetic relation toward nature. The investigation under proper guidance would suggest the fundamental laws already alluded to.

Too much cannot be said as to the formation of habits. By eight or nine the brain reaches the adult size, the fundamental lines are formed and habits contracted become established to show in after years. If habits of indolence, carelessness, disrespect of surroundings have been allowed to develop the reformation in after years will be difficult and perhaps never wholly accomplished. When ready for High School Biology the pupil should be acquainted with nature to the extent that he would know where to get it, and how to handle it after having it in his possession. He should know the parts and their relation in a general way to each other. The inability of pupils to handle material, the timidity in the presence of material is the time wasting element in High School work. Artificial surroundings have made the natural foreign to the senses. The material to appeal to the child must be seen in its natural habitat. The struggle for existence and the protective measures for that struggle appeal to the emotive and intellectual side and stimulate to action.

In treating the subject in a scientific spirit, facts in sufficient number should be in evidence before a conclusion is drawn. Plants and animals should not be presonified or endowed outright with motives.

The use of technical terms has been a subject of much discussion. In most text books on Biology the technical terms used are thoroughly incorporated in the language of the subject and contain no objectionable terms. Desirable technical terms are acquired when learning the thing to which they belong with as much ease as a foreign language, when a part or organ is discovered a name becomes a necessity and used as a means to communicate and point out to others the name is easily acquired.

But with the many good outlines in the field with a definite understanding as to what should be the preparation for High School Biology we are still confronted with the problem of arrangement of subject matter to bring about the desired relationship between nature study and High School Biology due perhaps to the existing experimental stage of High school Biology and the failure to introduce nature study in the grades. In most cases High School Biology starts with the High School and extends through a period of one semester or two semesters at the most. The pupil appears for the first time in the class-room without any idea of what is expected of him. His habits as to manner of study are fixed to a great degree. He is not in a position to observe and experiment. Ask him a question concerning a certain twig or branch and he will peruse his text for an answer. He will jump at conclusions without reason. There is in the young mind a habit of verbal memorizing, the placing of general notions due to the text-book work. First, then, there must be a reconstruction in the habits of thought which have been successful. At best you have a student beginning nature study. Under such conditions I believe the grade work should be presented in an abbreviated form and if possible bring about a right relationship between the child and nature and place him on a footing for scientific work. What the colleges desire is the student well grounded in fundamental principles rather than one who has a smattering of facts of no real basis for observation and reasoning.

In opening the discussion of the paper, Miss Gertrude Gillmore, of the Washington Normal School, of Detroit, contended that, while especially trained science teachers are necessary to organize and conduct the work, yet, the grade teacher is better fitted to teach the child directly as, she is more familiar with his environment and capability. In answer to the suggestion that the grade teacher is generally ignorant of what to teach and how to teach it, Miss Gillmore responded that she is to take up each subject a month beforehand and do a little at a time under the guidance of the special teacher, until she is prepared. Miss Gillmore then explained her method of conducting such work. Both speakers advocated biological material for nature work rather than minerals or physical phenomena, that are sometimes introduced.

THE RELATION OF LABORATORY, FIELD, AND RECITATION WORK IN BIOLOGY

MISS FRANCES L. STEARNS, ADRIAN, MICH

In Michigan it is no longer necessary to discuss the introduction of the laboratory method in biological sciences. It has proved itself the natural and substantial basis of the high school courses in these subjects and the well-equipped laboratory, if not a part of the school, is recognized as a legitimate demand. We claim for this work that it trains the pupil in habits of observation, accurate recording of observation,—thus developing good mental habits—clear reasoning, and well-balanced judgments. Therefore it better equips him not only to meet and settle problems of science, but to act wisely in the solution of all problems which life brings to him.

It has come to be recognized that the morphological and the physiological work which is possible in the laboratory fails in two directions. First, it fails to give the pupils a first-hand knowledge of plants and animals in their homes, an acquaintance with the life with them in the out-of-doors. A second phase of biological work which cannot be covered in the laboratory is the study of the relationships which exist between living things, their neighbors, and their environment,—the ecological aspect of biology. This department of science is most fascinating for the mature student for it gives him valuable information for the establishment of laws which govern life activities, and to the unscientific, even, the plants and animals become individuals, living individuals with interesting and original ways of doing things.

Field work as a method of instruction for high school pupils is as yet in its experimental stages. Those of us who have been in touch with the spirit of scientific work in this state must teach ecology whether we do so consciously or not for ecology is fundamentally a way of looking at things, the method of approach. It is the question "why" not "what." But the only logical order is *what*, then *why*. Bring these as close together as possible, but we must always precede the explanation,—the theory, by the information, the facts. Give the high school pupil both if you can, but I hold that we should spare no effort to give the boy the first key to the mysteries of life which surrounded him—the what.

There are some of us who still see value in the much ridiculed herbarium and natural-history collection. Field work is not this but it systematizes and organizes the methods and efforts called out by this kind of work.

It has been said that the kindergarten is the greatest institution ever devised for the education of the parents. I think field work is a close second. The unfamiliarity of methods and facts makes many parents skeptical; they do not see what it is all about. I once heard a man say he was completely demoralized when he went to the woods, and I think he expressed the feeling of not a few pupils. Is not the explanation largely their unfamiliarity with the surroundings? This man's ideals of life—and they were high—had not come to him through the channels of the senses but through written words. I think one remedy for this condition of mind is early work in nature study. When the trees, the flowers, the animals have gained an individuality for themselves, the center of interest will be transferred to them and the child will be left in the proper condition for healthy work,—complete consciousness of self.

The scheme of competitive gardening seems a most sane method of laying foundation-work for science and is certainly meeting with most gratifying results.

The poor grade teacher, ridden to death with fads, will probably groan to see another and will resent the suggestion that the herbarium and natural history collection belongs here. But when the instinct for ownership is strong, the body needing training, and there are endless animal spirits to be worked off, is not this a good time to answer the "What is it?" for natural science?

Until these preparations have been made, what can we do? Familiarize as much as possible by talks preceding the trip, by short excursions near home, by carefully prepared questions distributed beforehand, and ask the question "Why?"

Another word about the recitation. I have left it until the last because it should come last. It should not be the place to give information but one for the pupil to have opportunity of expressing what he has learned, for gathering up facts, and deducing laws, for classifying, and fixing the pupils ideas.

The laboratory, and recitation work, all make legitimate demands on the high school course, but the teacher, the laboratory equipment, the location of the school, arrangement of programme are all factors which must be known before the problem can be solved.

Following this, *Professor Chas. A. Davis, of the University of Michigan*, on the "POSSIBILITIES OF FIELD WORK," emphasized points made in the preceding paper, and contrasted past with present methods. He said all the difficulties of field work are no more fundamental or valid than the objections formerly urged against the laboratory method. The possibilities of field work are great when (1) teachers will prepare for it as they do for other kinds of work, by constant study of the region in which they teach; (2) the size of class sections taken to the field is small, not exceeding twenty; (3) the work is carefully planned and pupils are properly guided and watched; (4) the classes are questioned as to what they see, and are not simply told what the teacher sees; (5) when the special object of the exercise is coördinated with other related topics by questions and suggestions. Possible lines of work in botany, zoölogy, geology, and physiography were then suggested, and teachers who have to do this sort of work with their classes and hope to be successful were urged to take up field work for themselves.

In the discussion following it was evident that the majority of teachers did field work only as a side issue, and that this subject should be further developed; that twenty-five was as large a number as could be profitably taken at one time; that in cities much can be done in the parks; with large numbers it is better to have written directions or questions; that a successful way of doing field work is to take only the most interested students.

Acting on a suggestion previously sent in by Professor S. O. Mast, that it would be desirable to have a set of experiments in Plant Physiology, the chairman appointed a committee to formulate a set of such experiments, with suitable apparatus for a half or a whole year's high school course.

A paper from Miss Grace Ellis, of Grand Rapids, on "PHYSIOLOGY AS A SCIENCE STUDY IN THE HIGH SCHOOLS," made the following points: The optimum and logical preparation for physiology would be that botany, zoölogy, chemistry and physics should precede it. In case it cannot be preceded by these, simple experiments in chemistry and physics must be made in order to make the subjects in physiology comprehensible. Here is the starting point. In the laboratory, guided only by a sheet of directions and tested by questions, the learner finds out something of the composition of his own body. This introductory work may be followed by a set of simple experiments on acids and alkalies, then by tests for respiration, excretion, in order, ending with the study of the nerves and ganglia, especially as seen in the frog. All these are studied experimentally first. Physiology, hygiene, and sanitation should be the interpretation of the simple physiology of our course of study. It is desirable that there be a widespread understanding of the nature of contagious diseases in order that the action of medical boards and boards of health may have a meaning in the minds of

the public at large. The creation of such an understanding seems to me an important duty of the public schools.

Mr. Raymond Pearl, of the University of Michigan, then read a paper on "PRACTICAL PHYSIOLOGY IN THE HIGH SCHOOL." He said in substance: Physiology, as taught in the average high school, is open to criticism from three general standpoints. These are: (1) high school physiology comprises for the most part something other than true physiology; (2) its purpose is too largely one of attempting to impart a concrete knowledge of the human body, without regard to general training; (3) the method of presentation to the student is faulty for two reasons: First, in that the most complex rather than the simple is taken as the starting point; and second, in that the subject is presented dogmatically, i. e., something finally known.

The most important things which will contribute towards the elevation of high-school physiology to the level where it ought to stand are: (1) the use of a rational laboratory method for the purpose of developing the student's general mental powers; (2) the presentation of the subject as a living affair to be investigated, not something dead to be memorized; (3) the substitution of the standpoint of "general physiology" for that of "organ physiology;" (4) the presentation of something of the historical development of the science as a practical means of holding the student's attention.

The program closed with a paper by *Dr. H. S. Jennings, of the University of Michigan*, on "SOME BIOLOGICAL PROBLEMS."*

At the close a resolution was offered that, as physiology in its broader sense is one of the biological studies and may, if properly taught, be made of equal value with any other, it should justly be recognized by university authorities, and that such recognition would promote its better teaching.

Second Conference of the Biological Section

JOINT SESSION WITH THE MICHIGAN ACADEMY OF SCIENCE

In a paper on "ORIGINAL WORK FOR THE HIGH SCHOOL TEACHER," *Mr. E. L. Moseley*, who has done so much for science in the Sandusky High School, gave a most striking illustration, a concrete example, of a piece of original work he had done in locating buried valleys of streams running into Sandusky Bay. His boys accompanied him at one time or another, and one of them helped in the discovery of an old creek bottom that explained one of the problems that was at the time puzzling them. It was shown that such work may furnish a valuable basis for future engineering operations. . . . The conclusion reached was that the valley now filled with mud and covered with water must have existed before the waters of Lake Erie had been raised so far westward, and that if this rise continued, ultimately Sandusky, Toledo, and then Chicago, would be submerged. He then said: "I have been asked to answer certain questions pertaining to original work for the high school teacher. First: how to get a subject? Become a member of the Academy of Science and attend its meetings. You will find out in that way what other investigators are doing and learn of a number of things that need further study. When possible, attend also the meetings of the

* The manuscript for this paper was not obtainable.

American Association for the Advancement of Science. At Pittsburg beginning June 28, will be the last of the summer meetings. After 1902, the annual meetings are to be held convocation week and the first will be in Washington about Jan 1, 1903.

If you can induce scientific men to visit you, you may get valuable hints as to problems for the solution of which your locality affords peculiar advantages. By a few minutes' conversation you may learn things you were anxious to know and could not find out by hours of reading.

A desire to know is the best stimulus to investigation. Oftentimes the result may not be worth publishing, but it is a satisfaction to have learned something about the subject by your own researches. Such knowledge means more to you than what some one else may have found out about the subject, just as the pupil gets benefit from performing experiments for himself instead of merely seeing them performed.

The second question is: how to find time for original work? First, by giving up other things. Miss Cole, who has given us the admirable Flora, of Grand Rapids, Mich., and vicinity, for years devoted to the work her spare time on school days and Saturdays, and the greater part of summer vacations, when she would find board for a week or two at some farm house in a good location and then go to another district until she had made a thorough study of the flora of sixteen townships. The enthusiast in any subject is willing to sacrifice many other things in the pursuit of it.

Many a teacher has the talent to illumine some scientific subject, if it were not overshadowed by the desire to make money. Many whose aptitude for research would lead to valuable discoveries are tempted by the prospect of better pay to seek and ultimately to find a position whose administrative work is too onerous to allow any time for original research. Others devote what spare time can be spared from school work to hearing private pupils, or to some business that can be attended to on Saturdays or after school hours.

Few teachers of science can have any reasonable expectation of getting rich as a result of their discoveries, and if they are not contented to live in a humble way but consider riches essential to their happiness, they are not likely to use any portion ot their slender income for original research or devote to it any time which they might utilize for remunerative work.

The investigator who is devoted to his work may find it necessary frequently to curtail the time he would like to devote to literature and newspapers, to learn ths news of current events mostly from weekly papers or from magazines whose news is more important and reliable than that of the daily papers, and to have some one who has time to read the latter tell him the things in which he is likely to be most interested.

More important than all other means of securing time for original work is the maintenance of health, for its impairment means not only the shortening of life but greatly diminished capacity for labor.

Besides insisting on good ventilation the teacher should be outside at least one hour out of every twenty-four. Living at some distance from the schoolhouse and not using a street car may insure this. The teacher of biology can do much to preserve his health if he goes after school to collect material for his class or to enjoy and study nature in the fields and woods and much for the health and pleasure of his pupils if he takes them along.

Rest after meals and regular and sufficient sleep may prevent one from accomplishing so much in a certain week or term, but will enable him to accomplish more in a lifetime. Likewise mild stimulants, to say nothing of strong ones, diminish in the long run one's capacity for work. Shortsighted is the author of a physiology who commends coffee because it destroys the sense of fatigue. Ambitious persons are prone enough to work on, after brain and nerves and eyes have been taxed until further strain will prevent them fully recovering their original vigor. They need no artificial stimulant to spur these organs to herculean efforts or make them obiivious to the warning of the sense that tells them it is time to rest. With many teachers doubtless the habit of working late at night is contracted while at college. In the literary department working late was formerly not necessary for most students, and it is not now, though many seem to assume that it is. Young ladies who stand high in their classes and yet always retire early, inform me that those who do differently fritter away much of their time during the day, depending on the night time for study.

Frequent moving from place to place may facilitate the study of certain subjects, but for others it must be a serious hindrance. The investigator should have books and notes and specimens classified and arranged so there will be no delay in finding what is wanted. In moving, not only is much time required for packing and unpacking, but much interesting material must be left behind, some things are lost and others broken, the work of rearrangement, which at best will require weeks for a large collection may be interrupted for months or years for the lack of room and suitable cases, and when done, the owner may require a long time to become as familiar with the new arrangement as he was with the old.

After the teacher has been some years in the place and won the respect of many people, they no more think of ousting him because of petty faults than one who was born among them.

In many lines of research acquaintance with the region and with the people such as one cannot get in a single year greatly facilitates one's work. Numerous illustrations of this might be given, did time permit. But the most serious objection to frequent moving is that lines of investigation pertaining to the locality require years in order that the work may be done with such thoroughness as to make it of permanent value.

The teacher of natural science who would imbue his pupils with the spirit of investigation should not be content to invoke their assistance in prosecuting his own researches. He should inspire them with a love of nature. To do this he must take them into the country. Some teachers whose early life was spent in the country or in a village fail to realize when they begin to teach in a city how meagre is their pupil's experience with the subjects they are trying to teach them. Until I take them into the country, some of my pupils have never seen a sheep, a peacock or a snake. Some imagine that strawberries grow on tall bushes. Many of them have scarcely, if ever, in their lives seen a hill or a river, save sometime, perhaps, from a car window. The expressions, "up stream" and "down stream" are meaningless to them. They listen attentively in the classroom to a description of the characteristics of a lake beach, but when shown a mole hill they are not sure that it is not a lake beach. Nor have they more knowledge of a beech tree. Not one in ten ever saw beech trees until taken to them by their teacher. The same is true of the hemlock, the witch hazel and many other interesting plants. Other trees, such as the button-

wood and ash they have seen but never had an opportunity to learn to know them. They do not recognize the note of the meadowlark or the kildeer, or know the difference between a chipping sparrow and a chipmunk.

The burrow of the woodchuck, the chimney of the crayfish, the ants caring for their pupæ and for the plant lice, the protective resemblance to their surroundings of the rabbit, or the grasshopper and whip-poor-will, the protracted flight of the swallow and the quick movements of the kingbird, the singing of the bobolink and brown thrasher;—these things cannot be brought to the school-room. Yet these, and not dried specimens, represent life. To fail to give them any knowledge of these things is to deprive them of a source of enjoyment whose pursuit would do more to enrich their lives than any luxuries that money can buy.

In the discussion following, two of the University men held that it was difficult to find problems on which high school teachers could work, and that they did not usually have the time, though it was held that some sort of original work was almost essential for the best kind of teaching. Yet the principal speaker on this topic, a high school teacher, had done very creditable science work, presenting at the opening of his paper an unfinished piece of work, which was original, to say the least.

Another member, however, presented a more encouraging view of this unpromising situation. He said what holds teachers back from attempting original work is the idea that they must do something great or nothing at all; but little things add to science. There are scientists in the state who wish to enlist teachers in small problems on distribution. Very simple things can be done along this line which in their broader meaning may be very complex. The mere collection of material, when the locality is known, is of importance.

The Description of a New Biological Laboratory

SAMUEL O. MAST, PROFESSOR OF BIOLOGY, HOPE COLLEGE, HOLLAND, MICH.

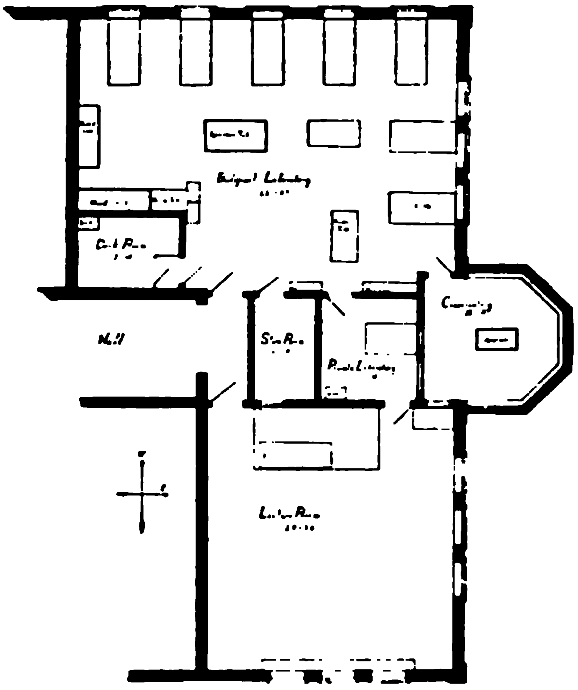
The plans here presented were drafted for a biological laboratory in process of construction at Hope College, Holland, Mich.

The laboratory will occupy the entire east end of the second floor, and in order to avoid direct sunlight as much as possible, will face the north. It is to accommodate 28 students, four at each of the seven working tables. These tables will be supplied with four drawers on either side. The drawers will be arranged one above the other in the middle of the tables. Adjustable swivel chairs with backs will be used at the tables.

There is a conservatory for plants, with glass roof and sides, and a cement floor connected with the sewer system by a drain. The dark room is to be used both for performing physiological experiments in the absence of light and for work in photography. The store room will accommodate not only biological material, but also chemical glassware, stains, etc. A hood which will accommodate three students at one time is supplied with water and gas. The lecture room will seat forty. It is adapted for demonstrations as well as quizzes and lectures, being in close connection with the store room, the private and the general laboratories.

We have planned a private laboratory, 9x12 feet—rather small, but better than none. As it is lighted only through the conservatory, it is

supplied with both gas and electricity. Every instructor should do some special work. This does not necessarily mean that every instructor should be an original investigator; he should be a teacher first of all. The special work he does may be the preparation of material in new ways for student use, or the working over of old experiments. Such a room, where the instructor may work undisturbed by the thoughtlessness of students, will also give them a wholesome notion of the difference between private and public laboratory belongings.



In discussing this paper, *Miss Edith Pettee, of the Eastern High School, Detroit*, gave a description of their NEW BIOLOGICAL LABORATORY, and some of the principal features are here given as it presents the high school side of the same question:

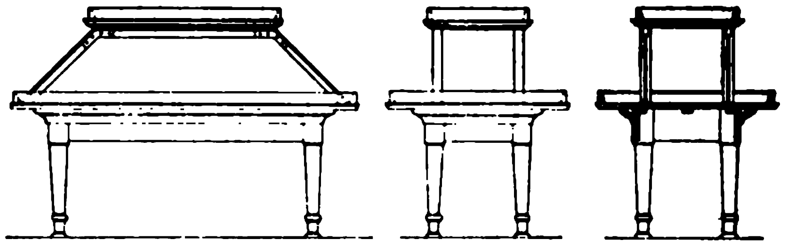
The laboratory faces the north and has three double windows on that side. Before each of these is a large flat iron shaped table, seating eight pupils, with drawer accommodations for four sections. The large table is convenient for beginning classes when materials are used in common while the sloping sides give better light to those away from the window. This light is not as good for compound microscope work as could be gotten at smaller tables before a greater number of windows.

At C is a slate topped table with water and gas and a sink at one end. D is a teacher's table. Both these tables have drawers and cupboards underneath. There are also two cases for apparatus and materials.

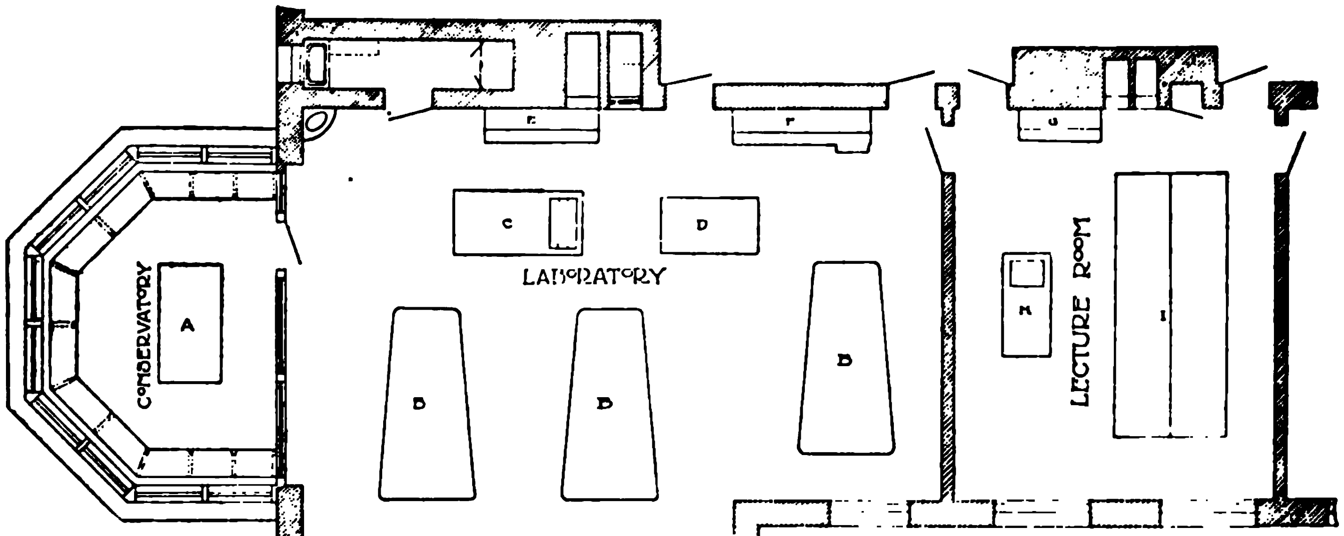
At the side of the laboratory is a small store room which has cupboards, a sink, and a zinc lined wooden box to hold earth. This can be rolled into the conservatory and is a great convenience in potting plants. In this closet is also a gas hot water heater which is connected with all the sinks, a hand basin in the corner of the laboratory, and the conservatory. Turning on the water turns on the lighted gas which heats the water as it runs through the pipes.

A plate glass partition separates the laboratory from the conservatory which has double windows for sides and a double ground glass roof. The cement floor slopes toward a drain pipe in the center.

The metal covered, asbestos lined plant benches are around the sides with steam pipes underneath. It would be better to have the pipes on the



¾" SCALE DETAIL OF TABLE A



PLAN OF BOTANICAL DEPT
EASTERN HIGH SCHOOL
Scale - ⅛" per 1'

These cuts are reduced to one-third size of drawing.

floor as the benches get too hot for the plants. There should be a thermostat connected with the steam pipes. A double-decked aquarium table stands in the center of the conservatory.

The recitation room (lecture room) has a raised platform at I allowing three tiers of seats. There is a long demonstration table, H, which has water and gas and a covered sink at one end. There is a small closet and a case for specimens, G.

In a short talk on "METHODS BY WHICH NEW VARIETIES OF CULTIVATED PLANTS ARE ORIGINATED," *Professor C. F. Wheeler, of the Michigan Agricultural College* gave many ways in which the horticulturist produces such interesting results. Some new products were mentioned,—a daisy, four inches across, will soon be common property. In illustration of the ability of plants to vary with their surroundings it was said that the "dented corn" of the South may be changed to the "flint corn" of the North after three years planting in the latter latitude. In the discussion that followed Professor Davis called attention to the fact that the garden radish, the cabbage, and the cauliflower were the result of selection acting on the plants of the mustard family that had, respectively, somewhat thickened roots, or leaves, or flower-stalks.

Mr. J. W. Matthews, of the Western High School, Detroit, then spoke on "THE KIND OF ZOÖLOGY FOR HIGH SCHOOL WORK," saying in substance: The discussion of the subject of zoölogy in the high school should answer three questions: Why study zoölogy in the high school? When shall it come in the course of study? What shall be the branch of zoölogy presented?

There is no study in the curriculum that can produce better development of the powers of observation, comparison, and classification. No other subject gives such natural material for the development of observation, which is the first step in all study, and comparison, which establishes the facts thus gained, and classification, the logical conclusion. Pupils readily feel at this age the philosophy of the general laws of life, and need the breadth given to thought by considering human life in connection with animal life.

The best time for zoölogy is the second year of the high school course, following a year of botany, which shall have consisted of the study of plants as a whole, their habitats, when they flower, their method of flowering, their uses, etc. In fact much work in "God's laboratory" rather than confinement within the walls of a building with expensive apparatus and a few plants. A high school following such a plan for five years sent out six students who specialized in biology and were chosen assistants in the University of Michigan; four others, who went from college to teach biology in the public schools, or to follow lines of nature work; thus making ten pupils in that period of time inspired to choose life work in biology.

The conference closed with a lecture on "THE GERMICIDAL ACTION OF METALS AND SUNLIGHT," by *Dr. F. G. Novy, of the University of Michigan*. On account of his researches along this line much interest was taken in what was said, an abstract of which is here presented:

The surface or contact action of metals has been studied by chemists for many years. It is well known that certain metals as platinum and especially palladium absorb relatively enormous volumes of hydrogen. The gas is held in combination with the metal and is easily given off in a dissociated or active condition. As a result palladium-hydrogen is capable of exerting

a marked oxidizing action. It may convert, as Hoppe-Seyler pointed out, benzol into phenol, aldehydes into acids, liberate iodine from potassium iodide, etc. Moreover, hydrogen peroxide is formed when it is brought into contact with water.

The contact action of platinum is especially seen in the manufacture of fuming sulphuric acid by the new method. When platinized asbestos at a high temperature is brought into contact with oxygen and sulphur dioxide the metal acts as an oxygen carrier and the result is the formation of sulphur trioxide or sulphuric acid. By this procedure it is possible to prepare pure fuming sulphuric acid and it is more than likely that the "lead chamber" method of manufacture will be entirely done away with.

In 1889 Dr. Miller, the well-known American dentist of Berlin, showed that certain metals such as gold and copper exerted a marked germicidal action when brought into contact with bacteria. He explained this action as probably due to oxygen condensation on the surface of the metal. Behring, the discoverer of dipththeria antitoxine, repeated and confirmed Miller's experiments but the explanation which he offered was very different. He held that the bacteria, by means of their soluble chemical products, dissolved traces of the metals and that thus the germicidal action was brought about. In their studies upon the formation of organic peroxides, Drs. Freer and Novy showed that these substances are readily formed when some metal or even fabric was introduced into the mixture of the ingredients. In other words the surface or contact action of metals was manifested in much the same way as in the manufacture of sulphuric acid by means of contact with platinum. The view was expressed that probably the germicidal action of metals was due, not so much to the solution of the metal employed, as to the formation of peroxides by surface action.

It is well-known that sunlight is destructive to bacteria and the only explanation from a chemical standpoint which has been heretofore brought forward is that hydrogen peroxide is formed under the influence of the sun's rays. There can be very little doubt about the formation of this substance under those conditions, but the amount that is present is hardly sufficient to account for the rapid and intense germicidal action observed. The ultra violet rays are especially active in this regard. The explanation of the action of the sun's rays must be due either to the formation of powerful organic peroxides, such as those described by Drs. Freer and Novy, or to ionization. Investigations along these lines are now being carried on in the Hygienic Laboratory of the University.

PHYSICS SECTION

The Speaking Arc and Wireless Telephony

BY K. E. GUTHE, UNIVERSITY OF MICHIGAN

Ever since the invention of the electromagnetic telephone scientists have tried to reproduce sounds by means of instruments based on an action of the electric current other than magnetic.

Sir W. Preece of England made the first, and, to a certain degree, successful, attempt in this direction by constructing the so-called thermo-

telephone (Proc. Roy. Soc. Apr. 28, 1880). He made use of the alternating heating and cooling of an electrical conductor when a current of varying intensity passes through it. A fine wire subjected to a relatively strong tension is fastened at one end to a membrane. As an electric current is sent through the wire the tension will decrease, while on cooling it returns to its original value.

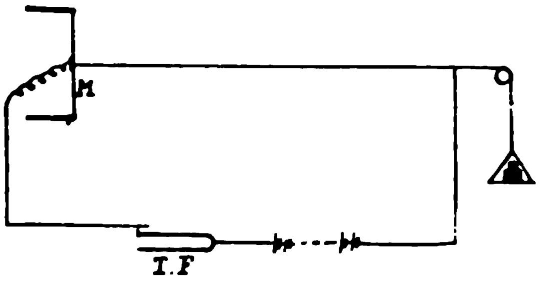


FIG. 1

By these variations in the tension the membrane is set into vibration and produces a sound.

All depends, then, on the ability of the temperature changes to keep step with the variations of the current, which may be produced in the ordinary way by a microphone. The wire of the thermo-telephone must, of course, be very thin to fulfill the above condition. Preece used a platinum wire 0.0076 centimeter in diameter, and finds that "the articulation, though muffled, was clear, and words could easily be heard." You see a similar instrument here [indicating]. The instrument exhibited is diagrammatically shown in Fig. 1. A phospor-bronze wire 90 centimeters long and 0.02 centimeter in diameter is subjected to a tension of about 200 grams. The membrane (M) is a bladder, which I put freshly on the frame about a week ago. The wire forms part of a circuit leading into one of the further rooms of the laboratory, far enough away to exclude all possibility of our hearing the source of sound directly. In that room a tuning fork is set up, which, as it vibrates, makes and breaks the current. As soon as I turn the switch so as to connect the wire with the circuit, all of you can hear distinctly the sound corresponding to the pitch of the tuning-fork.

Certainly an instrument like this can never vie with an ordinary telephone receiver as far as transmission of speech is concerned, and, indeed, for just about twenty years the electromagnetic telephone reigned supreme and without fear of competition.

The conditions have changed somewhat since the "speaking arc" was discovered. Here, as in so many cases, we owe most of our knowledge to the scientific and thorough following up of an accidental observation. In

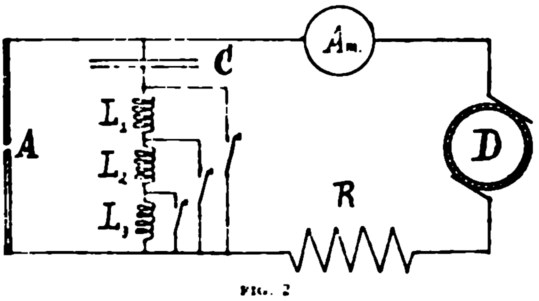


FIG. 2

the fall of 1897 Dr. Simon observed while working with an arc light in the physical laboratory of the University of Erlangen, that it produced buzzing sounds similar to those caused by the making and breaking of a primary circuit of an induction coil in an adjoining room. Investigation showed that the two circuits ran parallel to each other for about 15 meters, and that thus currents induced by the working of the induction coil were superposed upon the steady arc-light current. The variations in the current

through the arc gave rise to variations in the density and volume of the incandescent vapor column, and these to sound vibrations in the surrounding air. (Described in Wied. Ann. d. Phys., 64, p. 233, 1898.)

From this observation it was not such a wide step to a reproduction of human speech by the arc light. It was only necessary to superpose the varying currents of a microphone circuit upon the arc-light circuit. The experiments undertaken with this in view have proved, within the last year, remarkably successful.

But, before exhibiting the properties of the speaking arc, or, more strictly, the speech-reproducing arc, let us first consider the arc itself, without any reference to the impressions it gets from the outside. Curiously enough, all these years that scientists were looking for a sound-producing effect of the electric current, the arc has been humming and hissing into their ears without their understanding the meaning of it.

It was Duddell who first found out that the arc was a musical body, and that it was only necessary to give it proper opportunities to have it sing any tune desired. Duddell read in December, 1900, before the English Institution of Electrical Engineers, a very interesting paper on rapid variations in the current through the direct-current arc. That part of his work which is closely connected with our subject deals with the production of clear whistling sounds by the arc itself, when put in parallel with a capacity and an inductive coil whose coefficient of self-inductance may be L. Such a circuit forms an electrical resonator, whose vibration number n is given by the equation

$$n = \frac{1}{2\pi\sqrt{LC}}$$

The resistance, if very small, may be neglected.

All we need, then, is to set this resonator into vibration. It is not necessary to produce in the current variations of the same frequency, but simply to give it many and repeated impulses, just as a tuning-fork is set into vibration by being bowed. These impulses we can easily obtain if we make the arc very short—about one millimeter in length. The burning is then rather irregular, and carbon particles are liable to short-circuit the electrodes frequently, thus continually producing changes in the current. Under such conditions the arc will sing.

The apparatus is shown in Fig. 2. (A) represents the arc, (C) the condenser, (D) the source of current, and (R) the resistance. I have arranged a number of keys in such a way as to cut out different sections of the self-induction, (L_1), (L_2), (L_3), or the whole of it. According to which key I press down, you will hear sounds of a different pitch, all rather high, but distinctly of a musical and not unpleasing nature except when I short-circuit the self-inductance. Then the sound becomes too shrill to be called pleasant; its frequency lies somewhere between 10,000 and 12,000.. If the key connecting the arc with

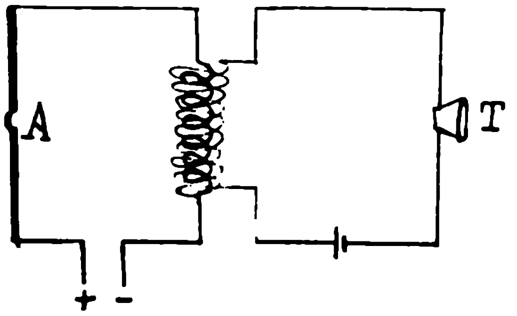


FIG. 3

the resonator circuit is opened the sound stops instantly; on the other hand, notice that no whistling can be produced when the arc is longer and the light steady.

A point of the greatest interest is that we have here the means of producing, by a constant-current dynamo, rapidly alternating currents in the branch containing the condenser and self-inductance, while in the arc we have a pulsating current.

Duddell stated that the hysteresis of an iron core in the inductive coil will instantly stop the tone. I have not found that to be the case. Even with an iron core, the singing can be produced without much trouble, though, I admit, not as easily as without the core. Further, the sound is more liable to vary in pitch, so that for the singing of a regular tune the iron core should be omitted.

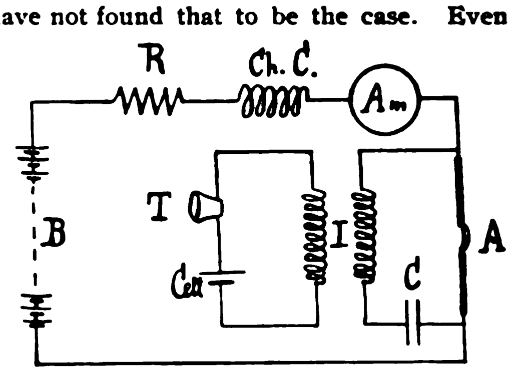


FIG 4

Using a self-inductance with an iron core, made up of a large bundle of thin iron-wire, in series with the capacity, we can make the arc sing. The alternating current produces now a very rapid change in the number of lines of magnetic force. Thus, we can reproduce the famous Elihu Thomson experiments, of which I shall give only two.

If we bring a closed wire near this magnetic field varying at a very rapid rate, currents will be set up in it by electromagnetic induction. On putting such a wire, consisting of several parallel coils and connected to the terminals of an incandescent lamp, on the iron core, the lamp glows. By rapidly slipping this metal ring over the inductance we decrease the self-inductance, and the tone of the arc becomes higher. As soon as the whistling of the arc stops, or as soon as the self-inductance is short-circuited, all these phenomena disappear.

Now let us return to the "speaking arc." The variations in the volume of the incandescent-vapor column are mainly due to the changes in temperature produced by the variations in the current. Suppose that the Joule effect is the same for the arc as for a metallic conductor; then the heat produced in unit time would be given by the formula

$$H = i^2r,$$

$$\text{and } dH = 2ir\, di.$$

Though this supposition is not exactly correct, experiments carry out the conclusion that the sound effect will be the larger with (1) the larger the variation of the current, and (2) the larger the current through the arc itself.

The number of arrangements proposed by different observers for the best working of the experiment under consideration is quite large. In Simon's original arrangement (Fig. 3) the transmitter (T) was put in series with a cell and one coil of a transformer, while the other coil was in series with the arc. Duddell, (Fig. 4) makes use of a choking coil (Ch.C.), to prevent the variations of the current from passing through the dynamo, and puts the transformer coil (I) and a capacity (C) in parallel with the arc.

I have found, however, that we can produce very satisfactory and strong effects by the simple arrangement shown in Fig. 5.

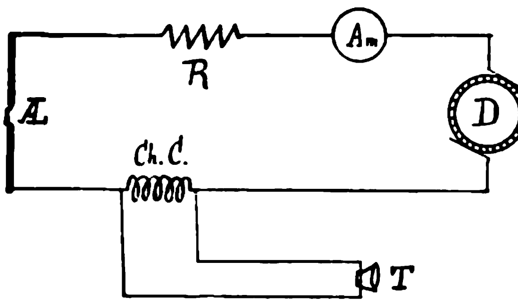


FIG. 5

The arc is produced by a continuous current of 12 amperes between carbons saturated with $NaNO_3$. By doing this we can easily obtain an arc five centimeters long. In series with the arc is a choking coil (Ch. C.), formed by a coil of a large electromagnet ($L=0.007$ h). No capacity is needed in the circuit, and the current is adjusted by ordinary rheostats (R).

The circuit leading to the room where the transmitter (T) is set up is connected to the terminals of the choking coil. The current through the transmitter (Mix and Genest) is about 0.5 ampere. This arrangement is extremely simple, but entirely sufficient to reproduce speech and other sounds with perfect distinctness.

[The experiments consisted in the reproduction of ordinary conversation, various songs, whistling, and violin playing, all being heard distinctly by everyone in the large lecture room, seating one hundred and sixty people.]

Of course, the breaking of the arc stops the sounds, but I observed that for a very short time after the breaking the sound continues, though rapidly decreasing in intensity, showing that the heated gases continue to conduct for a short time. This seems to have escaped other experimenters.

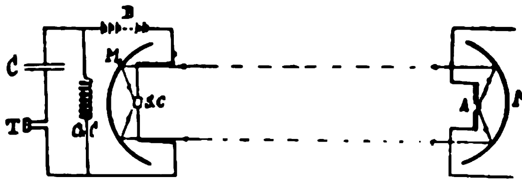


FIG. 6

The arc light then acts as an efficient telephone receiver. Attempts have also been made to use it as a transmitter. Any disturbance of the arc produced by impinging sound waves will change the resistance and consequently the current in the arc-light circuit, which may then be heard in a receiving instrument connected in parallel with the circuit. The results have not been very satisfactory, as the sounds heard are not very loud, and, besides, are mixed up with disturbing sounds, due to the irregularities in the arc light itself.

Since we live now under the sign of wireless telegraphy, it may be of interest that wireless telephony is made possible by the invention of the speech-repeating arc. We may simply make use of Bell's well-known scheme of throwing a beam of light upon a concave spherical surface at whose focus there is a selenium cell. Any change in the intensity of the light will be accompanied by a variation of the resistance of the selenium cell. The whole arrangement is shown in Fig. 6. We have the speaking arc (A) at the focus of one mirror (M_1). The light and heat variations are sent out to the receiving mirror (M_2), with its sensitive cell (SC). This cell is connected in a circuit containing a telephone receiver (T), which responds to any variation of the current due to the change in resistance of

the circuit. The telephone receiver will thus enable us to hear what has been spoken into the transmitter of a distant arc-light circuit.

It is hardly wise to speak of a great commercial value of the speaking arc light or wireless telephony. Nevertheless, we can think of cases where they may be of practical value, but, even without that prospect, the musical and speech-reproducing arcs belong to the most interesting discoveries of the last few years.

NOTE:—A paper, treating a portion of the above subject more in detail, has appeared in the October number of *School Science*, vol. 2, p. 209-215, 1902.

Pupin's Invention

PROFESSOR G. W. PATTERSON, JR., UNIVERSITY OF MICHIGAN

Much interest has been shown by the scientific world in Professor Pupin's invention of the loaded telephone line, an invention which has vastly improved the transmission of speech over long distances. I may, briefly, recall the conditions present in the telephone circuit. The line has, sent into it, a certain periodically varying current, called a complex harmonic current. Very little of this current reaches the receiving apparatus at the distant end, in general less than one per cent. on long lines; the rest is abstracted by the charging of the line and held back by the line's resistance. If this resistance were absent, the charge waves would be transmitted without loss. So the electrostatic capacity of the circuit, in conjunction with the resistance, is an objectionable feature. If it were possible to suppress one or the other, long distance telephony would be possible to any distance. As it appears to be out of the question to suppress either, some counter effect must be sought. Now, it is well known that self-inductance combats capacity, and so increased inductance is the most evident remedy. But how to apply it was the puzzle. It was early suggested by some to put self-inductance in parallel with the capacity, but without good effect; others have tried large inductances in series, which also resulted in failure to produce the desired effect. The theoretical problem was so complex that no one before Pupin had solved it. Consequently, their experiments did not take the proper form. Professor Pupin first settled the theoretical problem, and followed with experiments performed under favorable conditions.

Pupin introduced into the line wire many small equal and equally spaced inductances. The introduction of more self-inductance demands more energy on the line to transmit the same current; but this is no detriment, as the increase of energy hinders the attenuation of the current from wave to wave along the line. Mathematically, a telephone line is like a vibrating cord, and although reasoning by analogy is exceedingly dangerous, yet it may be very helpful when the mathematical parallelism is close, provided it is checked by experiment. Pupin illustrates the telephone problem by means of the vibrating string. Suppose a very long, light, elastic string, which has no stiffness, to vibrate under the influence of simple harmonic impulses communicated to one end. If the string is long, waves will be produced which, because of air and other friction, have smaller and smaller amplitudes as they run along the cord from the source. With short

strings the phenomenon of stationary waves is produced, but in the case considered they are not present to any considerable extent. Had the string more mass in the same cross section, the damping of the waves would be less. Suppose, as a substitute for more uniformly distributed mass, we load the string at frequent intervals by means of many equal and equally spaced masses, we may approximate the uniformly loaded string. If, however, we apply the whole load at one point, or divide it among a few points, we will defeat our object, as the large mass will have a tendency to anchor the string and to reflect the waves and not to transmit them. Thus we may explain the failure of large inductances to improve telephony, when the inductances are located at a few points. Calling a whole wave length 2 Π, if the loads are at intervals A, so small that sin $\frac{A}{2}$ differs little from $\frac{A}{2}$ (say less than 2 per cent.), when the wave is well transmitted.

In the telephone circuit we deal with complex harmonic waves which consist of a combination of simple harmonic waves, each of the form

$$i = I\, e^{-bx} \operatorname{Cos}\,(pt - Bx)$$

in which *i* is the current at the distance *x* from the transmitter at the time *t*, and *I* is the maximum current at the origin.

The constants *b*, *p* and *B* have to do with the form and velocity of propagation of the wave; the constant *b* is the attenuation constant and has for its value

$$b = \sqrt{\frac{pC}{2}\left(\sqrt{p^2L^2 + R^2} + pL\right)},$$

in the case of uniformly distributed resistance (*R*), capacity (*C*) and inductance (*L*). If *L* is small in comparison with *R* this reduces to

$$b = \sqrt{\frac{pCR}{2}} \text{ (nearly)};$$

and if *L* is large in comparison with *R*

$$b = \frac{R}{2}\sqrt{\frac{C}{L}} \text{ (nearly)}.$$

In the former case higher frequency (larger values of *p*) causes more attenuation; in the latter case the attenuation is independent of the frequency within the limits of the approximation, and large values of *L* cause reduced attenuation. Both of these properties are favorably to good telephony; for small attenuation means loudness, and uniform attenuation for all frequencies means faithful reproduction of the quality of the voice.

To illustrate the application of the invention, we may take a line 250 miles long without the loading coils, suppose $L = 0$, $R = 9$ ohms, $C = 0.074$ m. f. per mile, $b = 0.000004$.

This small value of b (0.000004) would make it impossible to hear anything over the line. If to this line we add loading coils having a resistance of 9 ohms extra per mile (in all $R = 18$ ohms) and an inductance of 0.056 henry per mile, we obtain $b = 0.025$, in which case speech will be good.

I understand that the Bell Telephone Co. (Am. Tel. & Tel. Co.), to whom Professor Pupin has sold his invention for a princely sum, is now experimenting on a line 6000 miles long, obtained by using in series three New York-Chicago lines, which is equivalent to a metallic circuit between cities 3000 miles apart. The line is said to talk well, and it appears quite

probable that there will be no difficulty in using a line from New York to the Pacific coast. One big advantage from the commercial standpoint is due to the fact that a New York-Chicago line, which now costs $250,000 for copper alone, may be built with loading coils for less than half that amount. If the saving of capital is as great as expected, the price paid Professor Pupin will prove quite moderate.

Carman Opaque Projector

The "Art of Projecting" has a long history, and has developed many forms of apparatus. The "magic lantern" type and its modifications have become so familiar, and is in such common use, however, that it is unnecessary to discuss it. Projection by reflection is far less common; in fact, its possibilities are generally unknown.

Many years ago, attempts at projection by reflection were made in a small way, which resulted in such apparatus as the "Wonder Camera," "Megascope," "Aphengescope," etc. It is probable Chadburn was the first to design an instrument for making projections by reflection, and for a time it was known by his name.

All the earlier forms of instruments, however, attempted only the projection of small pictures of small area on the screen, and with but feeble illumination. Recently a German firm has developed a projector known as the "Epidiascope," a machine weighing many hundreds of pounds and costing many hundreds of dollars. It is highty organized, contains many mirrors, and gives satisfactory results only under the most favorable conditions, and then but for a short period of time. Extensive repairs are frequently necessary.

The Carman Opaque Projector, which is on exhibition before you to-day, is of less weight, is manufactured at a less cost, and is more durable than is any apparatus attempting to do what it actually accomplishes. It is believed to be the only single piece of apparatus that accomplishes the following results, passing from one form to another, without a moment's delay:—

1. The projection of opaque pictures in their true colors.
2. The projection of diagrams from sheets or books.
3. The projection of reading matter or music, from the sheet or printed page.
4. The projection of opaque objects either in a vertical or horizontal position.
5. The projection of all botanical subjects from life, in colors.
6. The projection of apparatus and small machines in operation.
7. The projection of microscopic slides.
8. The projection of micro-photographic slides.
9. The projection of stereopticon slides.
10. The projection of animated life by the use of the moving picture attachment.

The apparatus, as designed, eliminates all mirrors, unless the reversing effect is desired. This effect may be produced either by means of a mirror or a prism.

The features of the Carman Opaque Projector, to which especial attention is called, are· The objective lens, especially designed and built for the

apparatus; the automatic, 90° high candle-power electric lamps used for illumination purposes; the mechanical features making it possible to project stereopticon slides, microscopic slides, and opaque pictures and objects during the same lecture or demonstration.

The Projector which is in operation before you, has been purchased by the University of Michigan for use in the Medical Department, and others are soon to be placed in other universities and colleges.

You are cordially invited to make a close inspection of the apparatus now on exhibition, which inspection will convey to you far more definite ideas than can be given by an oral description.

The Nernst Lamp

SYNOPSIS OF PAPER

The Nernst lamp was originally designed and patented by Dr. Nernst of the University of Göttengen.

Later the lamp was brought to America by Mr. George Westinghouse, and further developed and patented by his employees, Mr. Wurts, Mr. Potter, Mr. Hanks and others.

The lamp is composed of five principal parts, as follows: The "glower," "ballast," holder, "heater-porcelain" and heater-case.

The glower is the part of the lamp that corresponds most nearly to the filament in the usual form of incandescent lamp. The difference between the filament and the glower is that the glower is made of a mixture of rare earths and a binding material, which are baked together into a slender tube of porcelain. The average tube is about 25 millimetres long and .63 of a millimetre in diameter.

A peculiar feature of the glower is that it is practically a non-conductor when cold, but becomes a conductor of the electric current when sufficiently heated. The glower is not contained in a vacuum bulb, but gives its brilliant white light exposed to the atmosphere. Under these conditions, the life of the glower is, on an average, greater than the life of the highest grade of incandescent lamp fitament.

The ballast is a steadying resistance introduced in series with the glower, for the purpose of regulating the current flow, and in consequence increasing the uniformity of light intensity and increasing the life of the glower. The form of ballast is unique in design, and involves many interesting principles. A full explanation would require more space than is allotted to me.

The heater is composed of platinum wire placed in a small tube of ordinary porcelain, which is placed directly above the glowers. By means of an automatic switch, the current is changed from the heater to the glower as soon as the glower becomes a conductor.

A heater case or glass globe is placed over the glower, in order to raise the temperature of the air in which the glower operates.

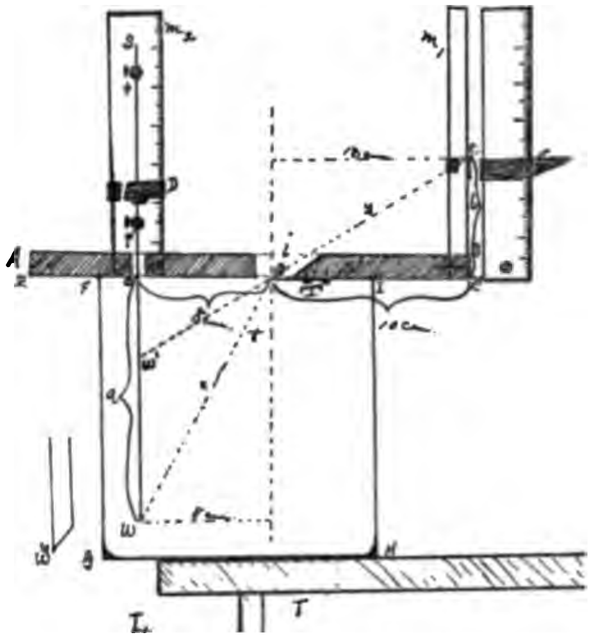
The lamps are made with one, two, three, six and thirty glowers. The efficiency of the six-glower lamp approaches that of the enclosed arc lamp. Tests seem to indicate that the single-glower lamp is at least twenty per cent. more efficient than the best vacuum incandescent lamps.

(ED.—A single glower and six-glower lamp were shown in operation by the speaker.)

The Index of Refraction of Water

CHAS. H. SLATER, PONTIAC, MICH.

The device herewith presented is developed largely from a similar one called an Indexometer, described in *School Science* last May. The method there suggested did not require a dark room nor a bright source of light and so was well adapted to our needs. The per cent of error seems rather large. Our students have used this apparatus in the laboratory with ordinary light and the per cent of error is less than one-half of one per cent.



Index of Refraction = u. i=angle of incidence; [1]R=angle of refraction

$$u = \frac{\text{Sin } i}{\text{Sin } r} \qquad \text{Sin } i = \frac{10}{y}; \ \sin r = \frac{8}{x}$$

$$x = \sqrt{a^2 + 8^2} \qquad y = \sqrt{b^2 + 10^2}$$

$$\therefore u = \frac{\text{Sin } i}{\text{Sin } r} = \frac{\frac{10}{y}}{\frac{8}{x}} = \frac{10\,x}{8\,y} = \frac{10\sqrt{a^2 + 8^2}}{8\sqrt{b^2 + 10^2}}$$

The construction and method of use is as follows: A rectangular glass jar, F G H I 6.5 cm. by 14 cm. and 18.5 cm. high is filled with the liquid whose index of refraction is desired. Upon the jar, and grooved to closely fit it, is placed a paraffined cover of hardwood, 10 cm. by 20 cm. and 2 cm. thick. This is provided with two openings, and two metric scales, each about 30 cm. long, mortised and glued into the wood at right angles to it as shown in the diagram. A small opening, C, is placed near one end to allow the free movement of the rod S-W (a coarse wire will do) which is fastened to the scale M₁ by means of two binding posts, p and p,[1] so placed

that at all times it will be normal to the under surface of the cover, A B. The scale is provided with a strip of brass, D, bent to clamp the scale and to extend behind and in front of the rod, thereby avoiding parallax. A mark for an index is filed on the rod. The central opening, 2.5 cm. diam., is bevelled back somewhat toward B. On the lower surface of the bevelled edge a piece of thin sheet iron, T, is fasted, so placed that its edge O is normal to the line Z'O Z and is 10 cm. from Z' and 8 cm. from the farther side of the rod S-W. This piece of iron serves as a sight edge at the surface of the liquid. The scale M, is so placed that one edge shall just touch the line Z'Z which passes through the center of the opening O, and should read from the lower surface of A-B. This scale is also provided with a brass sight edge, E, bent to clamp the scale and yet move easily along it. The rod, S-W is raised so that *W* is at *C*. This is done easily by placing A-B on a glass plate. While W is resting thereon the rod is clamped and a reading is made from the file mark on the rod. It is then lowered to any desired position, placed in position on the jar, and a second reading from the file mark is taken. The difference between these two readings gives the length *A*. If the point, W, be filed very oblique as at W'', it appears much more distinct. In practice it is very important that the sight edge plate T be covered by a thin film of the liquid or the surface will be greatly distorted and consequently a large error introduced. We have found it advisable also to place the jar as indicated on the edge of the table, and to place a common gas jet below or near as at L, to illuminate the point W when adjusting E. A ray of light from W passes the sight edge O, and is bent downward so that W appears to be raised to W'. The sight edge, E, is then adjusted so that W', O, and E seem to be collinear. The reading is then taken, and from this data, the index of refraction computed as shown in the formulæ and table of results. The apparatus is easily made and is inexpensive. The glass jar can be obtained from Eberbach & Son Ann Arbor.

DATA TAKEN FROM STUDENTS' WORK

Reading Z (point of rod, W, on Zero line) = 39.47 cm.

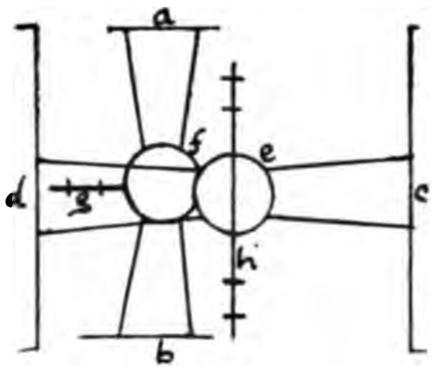
Name	Trial	Reading W, rod down	Z—W A	B	X	Y	$u = \frac{\sin i}{\sin r}$
Mal	1	24.45	15.02	12.50	17.01	16.00	1.328
G	2	25.44	14.03	11.40	16.14	15.06	1.317
M	3	26.54	12.95	10.35	15.22	14.36	1.324
G	4	28.30	11.17	8.20	13.72	12.93	1.326
M	5	29.00	10.47	7.20	13.17	12.32	1.335
G	6	24.40	15.07	12.60	17.06	16.08	1.327
M	7	25.60	13.87	11.40	16.01	15.16	1.328
G	8	25.00	14.47	11.70	16.53	15.39	1.342
M	9	26.65	12.82	10.10	15.11	14.21	1.329
G	10	27.20	12.27	9.50	14.64	13.79	1.327

Average value for u = 1.328
Correct value . 1.332
Error -- 004
Per cent = . . . 3-10 %

A Device to Show Composition of Vibrations

H. D. MINCHIN, INSTRUCTOR IN PHYSICS, CENTRAL HIGH SCHOOL, DETROIT, MICH.

The apparatus consists of two small pocket mirrors, *e* and *f*. The mirror *e* is arranged to vibrate vertically by being suspended to two vertical posts, *c* and *d*, by rubber bands.



The mirror *f* is suspended to a vertical post, *a b*, by rubber bands, and vibrates horizontally. The rubber bands may be fastened to the mirrors by wires soldered to the backs.

The two mirrors are so arranged that a beam of light incident upon *e* is reflected to *f* and thence to a screen.

Wires *g* and *h* are fastened to the backs of the mirrors, as per figure. Weights may be placed on these wires, and thus the velocity of vibration may be regulated. The source of light may be a ray of light from a lamp passing through a pin hole in a card, a lantern, or the sun.

By regulating the velocity and a proper adjustment of the tension of the rubber bands, any desired figure may be obtained.

The Joliet Township High School Physical Laboratory

W. J. RISLEY

Referring to the accompanying plan we find that the Department of Physics occupies seven rooms: A recitation room, general laboratory, office and private laboratory, dynamo room, lecture room, dark room and work room. They constitute the entire south and central portions of the fourth floor of the middle section of the building, and contain an aggregate of about three thousand five hundred square feet.

The lecture room, general laboratory and recitation rooms have each telephonic connection through the superintendent's office with the remainder of the building, a dummy electric clock and a thermostat. These rooms have each a large 8'9" by 3'0" instructor's table, while the office and work rooms have each a 6'4" by 3'0" glass-top work table. Each table has an abundance of drawer space, a stationary pneumatic trough, with waste pipe and connections for hot and cold water, gas, steam, compressed air and electricity.

In the general laboratory are eight stationary students' tables, 6'0" by 3'6" and 3'0" high, at each of which four pupils can work. These are fitted with individual gas cocks, cut-out boxes and cupboards, in which the pupils store their Bunsen burners, gas tubing, ring stand rods, rings and silk-covered cables for electrical connections. For ring stands, brass rods screw into nuts which are fixed in wooden blocks firmly attached to the under side of the table. An office stool, which can be placed under the

table is furnished each pupil, while at the ceiling above each table is a reflector for electric lights. A three-inch stone shelf extends along the entire south wall of the general laboratory and office, and along the east wall of the work room. Gauges for compressed air, gas, steam and water occupy convenient places on the walls, the last being immediately over a stationary marble-top washstand containing four basins. Eight windows, with an aggregate area of nearly two hundred square feet, supply an abundance of good light. These are fitted with ordinary curtains and with dark curtains, by means of which all light may be completely shut off.

The office has desk room for the head of the department and his assistant, a bank of drawers for apparatus, a library closet and a cloak closet.

The 34'0" by 27'0" lecture room, with a seating capacity of 100, has a large skylight just above the instructor's table, along the inner edge of which are six incandescent lamps. This skylight and the windows of the room have dark curtains, by means of which all light may be excluded. The seats are arranged in seven consecutive tiers, each 1'0" higher than the tier in front of it. On an ample platform in the rear of the room is the projection lantern, the 10'0" by 12'0" curtain for which is hung above the blackboard just back of the instructor's table.

The dark room will be fitted with the appurtenances which usually accompany such a room, including a complete photographic outfit for taking, developing and printing photographs and slides.

In addition to the above-mentioned laboratory table, the work room will be equipped with a large general work bench, an electrically-propelled lathe for both wood and metal work, and the necessary apparatus for glass-blowing and repairing.

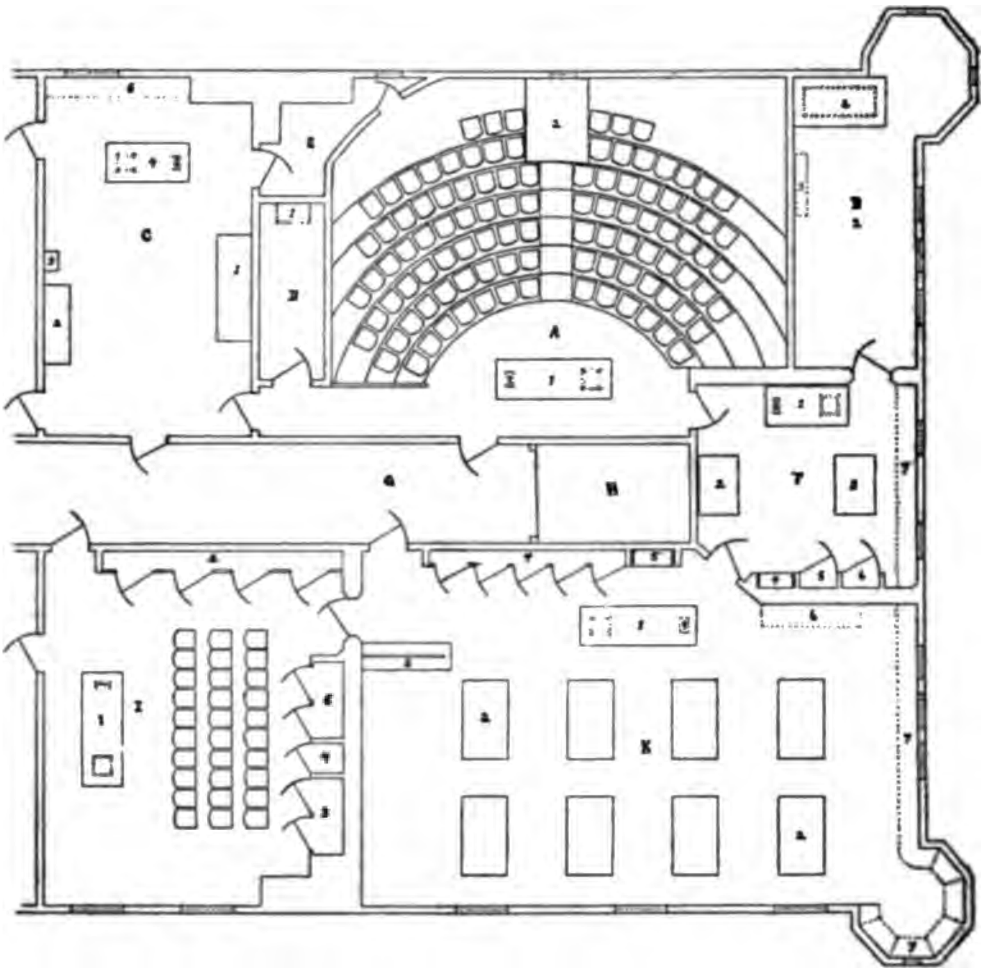
Beneath the raised portion of the lecture room is a large storage space for boxes, battery materials, etc.

Thirteen closets extend from the floor to the 13'0" ceiling, and having an upper and a lower section, are built in the walls of the general laboratory and recitation room. These closets vary in depth from 1'0" to 2'6", and in width from 3'0" to 4'6". Their heavy doors close against weather stripping, thus rendering them as nearly dust-proof as practicable. Two banks of thirty-two drawers each are used for smaller pieces of apparatus that have been assembled for the various experiments. Thus it is seen that we have sufficient shelf room for our present and future needs.

In the dynamo room a 3 K. W. motor is operated by power from the city electric light plant. To this motor is directly connected a rotary converter, which can furnish a 3 to 25 volt or a 25 to 125 volt direct current, a single-phase alternating current up to 90 volts, a double-phase or a triple-phase alternating current. The controlling switch board, furnished with stationary ammeters, voltmeters and rheostats, contains also cut-outs for supplying these currents for experiments to be performed in the dynamo room. Concealed cables connect it with the marble distributing switchboard in the general laboratory. This switchboard so stands that it can be studied from either side, and the cables be exposed for testing purposes, etc.

Switches supply the instructor's tables in the botanical and physiographical laboratories and all stndent tables in the physical laboratories with high and low voltage direct, and with city and single phase alternating currents. In addition to these currents all instructor's tables in the physical and chemical laboratories are supplied with two and three-phase alternating currents. With the necessary rheostats for regulating purposes, that

portion of the recitation work requiring electricity is now carried on very satisfactorily with the currents from our own converter. In the not-too-distant future we expect to have our own electrical plant to supply the entire building with light and power.



A. Lecture Room—
1. Instructor's Table
2. Platform for Projection Lantern

B. Dynamo Room—
1. Switchboard for Converter.
2. Rotary Converter.

C. Work Shop—
1. Work Bench.
2. Lathe for wood and metal.
3. Motor
4. Instructor's Table.
5. Stone Shelf

D. Dark Room—
1. Sink.

E. Toilet Room.

F. Instructor's Private Office.
1. Instructor's Table.
2.
3. } Desks.
4. Drawers for Apparatus.
5. Library.
6. Closet.
7. Stone Shelf.

G. Hall to Chemical and Botanical Laboratories

H. Stairway down to third floor.

I. Recitation Room
1. Instructor's Table.
2.
3. } Closets for apparatus.
5.
4. Elevator.

K. Laboratory—
1. Instructor's Table.
2. Students' Tables.
3. Switchboard for Students' Tables.
4. Closet for Apparatus.
5. Drawers for Apparatus.
6. Washstand.
7. Stone shelf.

Discussion of the Physics Note Book Problem

CHAS. H. SLATER, PONTIAC, MICH.

WHAT? When our laboratory work begins, each student is required to provide himself with two note books, a temporary book for taking down the data, etc., while performing the experiments, and a permanent note book in which the data for each exercise is carefully recorded and discussed. The former consists of a small, *bound* book, while the latter is a larger, well bound book of squared paper of medium quality.

WHEN? As the work progresses in the laboratory, the student records all data and observations in the temporary note book. All work is verified by the instructor before another exercise is commenced. The permanent record is then made by the student at home, and is occasionally called in by the instructor for examination and correction. Inasmuch as we usually have but two or three days a week for recitation, the first four or five weeks in the fall are given to text-book work entirely. This, however, lessens the time for laboratory work, hence it seems best here not to require the permanent record to be made in the laboratory, but to devote all the time at our disposal there to the experimental work. Later, at home, the student writes up his permanent record, which is more carefully done and more fully discussed than could have resulted from an endeavor to finish all work in the laboratory.

How? After the first two experiments are completed by all, detailed directions are given the class regarding how to write up and discuss the exercises in making the permanent record. One of the best note books of the previous year is obtained and placed where the students may examine it while writing up their first two exercises. These are to be finished by a certain time and handed in. This work is very carefully examined and marked for correction, and a part of a recitation period is given up to a discussion before the class of the mistakes, corrections, etc., and further suggestions are given for the future work. The books are not called in again until about twelve more experiments are completed. As all results have been previously verified, the discussion of the data, errors, methods, etc., of the experiment receive the most of the attention this time. Each book is then returned with a slip of paper upon which the most important criticisms are noted. Each student is required to see the instructor relative to these corrections. Subsequent examinations of the books are made in a somewhat similar manner, but less time is now required, as the method work by this time is quite well understood and few corrections will now be necessary.

SUPERINTENDENT C. L. BEMIS, IONIA

We have no room devoted solely to laboratory purposes in physics. The apparatus is set up on what might be called a shelf extending the length of the room. Two days each week are given to experiments in physics, and from two to six pupils work at the same time; two only on one set of apparatus.

Each pupil takes notes on what he does in the laboratory, draws pictures of the apparatus, and writes out descriptions of it on loose sheets of paper. These are corrected, after which they are copied into a book so constructed that each leaf may be taken out. After the copying is done, the books are again looked over, and if there are any errors of importance

the leaf is removed and the work copied the second time. Small errors are corrected, but for these the leaf is not taken out. When all is correct, the book is checked and considered passed.

I find that the two most difficult results to secure, so far as the books are concerned, are accurate expression and intelligible drawings. Of the two, the written part seems to be the most difficult, and it is only after repeated re-writing that I secure satisfactory results.

Every student should fill out a laboratory note book.

DE FORREST ROSS, SCIENCE DEPARTMENT, YPSILANTI, MICH.

The laboratory note book is by no means the least of the many perplexing problems that confront the teacher of physics. The average student takes to it as kindly as the boy of old did to the Saturday afternoon "composition." Hence, to make it more attractive and useful to the student is sufficient reason for its place in the questions of a Physics Conference.

That the note book, then, may serve its mission in the highest degree, it would seem to me of first importance that the student be made to see that it has a value to him that he can ill afford to be without. One way to bring this about is to have our colleges and university place a good deal of value on the note book from the high school applicants for admission to these classes, and then for the high school teacher to see that the student understands this attitude of these institutions.

Having established, then, in the student's mind a real value to his note book, he will now take more pride in making it more what it should be—a true record of his efforts, and highly intelligible.

It only remains now to so arrange the order and details of the experiment and observations as to show, in a clear, concise way, that the student has a fairly clear idea of just what he is doing and what he is doing it for. When this is so stated that, without covering a quire or two of note paper, the author will not need to be present to make his work intelligible to one looking over his record, the note book will possess more than a disciplinary value.

H. M. RANDALL, UNIVERSITY OF MICHIGAN

What to require of pupils in the way of writing laboratory notes is a question which does not seem capable of a definite decision, for it depends largely upon the time at the disposal of the teacher. The time for correcting notes, which may be time well spent in larger schools where not so much is demanded of the teachers, is likely to be very poorly spent in smaller schools where teachers are apt to be overworked.

The classroom work, including experimental demonstrations, and the work of keeping the laboratory and its apparatus in order should be well done, as it is by these means that the most physics can be taught, and until the teacher has enough time at his disposal to do this, and some to spare, it is likely to be a poor policy to undertake the correction of rather elaborately written note books.

For several years my pupils were required to write, first in temporary note books and finally in permanent ones, a statement of the problem, the apparatus used, give a complete description of the methods employed, place the results and computations in tabular forms, discuss fully what the results indicated, and make drawings of the apparatus, where such drawings

would simplify the description of apparatus or the method used. The correction and recorrection of such notes required about two hours of my time every evening. and as the forenoons were filled with recitations and the afternoons with laboratory work, there was not left sufficient time to make satisfactory preparation for either. As a remedy, the pupils were expected simply to write the problem, the apparatus used, put results and computations in tabular form, and state very briefly what the results showed. By previously discussing the laboratory problems quite fully in class, and having the laboratory apparatus always in order, it was possible to spend most of the two-hour laboratory period in quizzing pupils about the work they were doing, and to look over the brief notes at the completion of each problem, so that no additional time was required. The time formerly given to correcting notes was largely given to preparation for class work, and, on the whole, the subject was better taught.

W. A. MORSE, WESTERN HIGH SCHOOL, DETROIT, MICH.

In the high school, at least one-third the time given to the subject of physics should be devoted to laboratory work. It is here that the pupil acquires the habit of careful observation and the power to draw his own inferences from the work performed. A carefully kept note book should be the record of the laboratory work. In order that more may be accomplished during the laboratory period, we require the pupils to keep two note books: one (a temporary book) in which all mathematical calculations and manipulations of apparatus are recorded; another in which the working notes are copied, together with a drawing of the apparatus used. This, we believe, gives better opportunity for rapid work in the laboratory, and inspires the pupil to neatness and accuracy in the use of good English in writing out his final notes.

For the permanent notes we use the flexible self-binder, into which the cross-section paper can easily be inserted. All data should be taken at the time of the experiment, and under no circumstances should it be changed until after corrections have been added by the instructor. Both books should be placed in the hands of the teacher for correction, in order that he may see that no after-changes have been made.

The system of correction may be by check marks through the notes or by the use of numbers. We prefer the latter method, as it is less humiliating to the pupil and answers the same purpose.

H. D. MINCHIN, CENTRAL HIGH SCHOOL, DETROIT, MICH.

On the first day of the semester our classes meet for enrollment and assignment of lessons. We then request each pupil to provide himself with the following for laboratory work:

1. A laboratory manual.
2. A temporary note book.
3. A permanent note book.
4. A half dozen sheets cross-section paper.

The temporary note book is to be in size about 6 by 9 inches, containing about 130 pages, and a good quality of paper. The permanent note book is to be about 8 by 10 inches, well bound, good paper, and containing about 100 pages. We choose this size as it affords the required space for tabular forms, for data, without crowding.

On the second day of school the temporary note book and manual are to be brought to class, and we take about two-thirds of the recitation period to give directions for the drawing up of the tabular forms. These are to be drawn up in the temporary note book and handed in for correction. This is done outside of class, and thus the mechanical work is ready when laboratory work begins.

The temporary note book is to be used for all computing, and all observations and notes on the experiment are to be entered therein. This record is to show what the pupil actually observed and what he has to say of his observations.

As data are obtained we give methods of computing results, calling out by discussion what of the data calls for explanation and what results mean. Attention is called to limits of accuracy of data.

At the close of the period all results are checked, and pupils are then expected to replace all apparatus and leave desks in order.

We have tried two methods in discussing data.

1. The class method.
2. The individual method.

The latter is by far the more satisfactory, but requires considerable more of the teacher's time.

In writing up the experiment in the permanent note book, the following order is observed:

1. The first three pages are to be left for index.
2. Begin the writing of all experiments on the left-hand page. On the first line put experiment number and date; then the purpose is to be stated; following this a list of the apparatus with diagrams where necessary; the operations are then given. At the top of the right-hand page the tabular form is to be placed and the discussion follows.

In this discussion is brought out the meaning of the data, the steps in obtaining end sought and conclusion arrived at. The notes made in the temporary note book are used in this discussion.

Each experiment is discussed and written up immediately after it is performed.

Proceedings

OF THE

Michigan Schoolmasters' Club

AT THE

Thirty-Eighth Meeting

HELD IN

Ann Arbor, March 26, 27, and 28, 1903.

Michigan Schoolmasters' Club

PROCEEDINGS OF THE THIRTY-EIGHTH MEETING, HELD AT ANN ARBOR, MARCH 26, 27, AND 28, 1903

PAPERS

EDITED BY THE CHAIRMEN OF THE VARIOUS SECTIONS

GENERAL MEETING

THE DOCTRINE OF INTEREST AS IT AFFECTS EDUCATION.

PRESIDENT L. H. JONES, MICHIGAN STATE NORMAL COLLEGE.

Interest, as it affects the process of education, is a definite state of mind. It is produced by definite causes, and has definite signification suggestive of appropriate courses of action on the part of teacher and student. The possibility of this condition called interest lies in the self-active nature of the human being. The solicitations made by the external world through the senses arouse this self-active spirit, and suggest and stimulate its reaction upon the objects of the external world, and through these objects a reaction upon its own self, enabling it thus to master its own nature on the one hand, and its environment on the other. This continued mastery of the universe by successive steps, led by interest of one kind or another, is the real process of education. The perfection of education would involve knowing all about the capacities, the possibilities of the human spirit, or the self; of knowing all about all the objects of the universe outside the self; and of seeing and using all the helpful relationships of these objects to the self in the process of life development. Now, the spirit masters an object of study by finding out its attributes, and by viewing these attributes in respect of the self, it finds them gratifying or satisfying a felt need of the soul, the self-active character of the human spirit centers more closely its power of discovery upon the object whose attribute has thus gratified the soul,

through the belief in some form that further investigation will disclose in such object still other attributes which will also give satisfaction to the spirit. It is only under motive of some such kind as this that the self-active spirit ever gives its attention in study. Had it no knowledge of self, and had it never experienced the helpful effect of the attributes of other objects upon itself, no possible interest could be felt. Indeed, the infant has no interest. Its first actions are all instinctive. This interest represents a state of mind produced by the discovery in some object other than itself of an attribute which answers to a felt need of the spirit, together with the expectancy that the same object will, on further study, continue such gratification, or even increase it. Of course the state of interest may become exceedingly complex, as, indeed, it usually does; but gratification and expectancy are two permanent elements of interest. The purpose of this paper is, to some extent, to analyze these two elements and to discover if possible, their sources and the method of their development.

When an attribute of an object has been learned by the spirit in some self-helpful relation, and the expectancy of further gratification has been developed in connection with the same object, we are said to be interested in that object, whatever it may be. The class of objects in which we may thus become interested are as numerous and as diverse as the objects of the physical world outside us, as the mental and moral worlds within us, and as the great institutional worlds which we have created; but the interest itself, the gratification of the nature, and the expectancy, are always internal; that is, interest is a purely subjective, or personal matter. When I say that I am interested in a thing, I mean precisely that my mind is apprehending some one or more attributes of this object, and that this attribute or these attributes, through being thus apprehended, are giving satisfaction to me, or promise to do so through some use which I clearly perceive I may make of it or them in what seems to me to be my life development; and that there is in me an expectancy that this object will through this attribute or attributes, or still other of its attributes, continue to give pleasure.

To illustrate, let a horse-shoe magnet be placed before a child who has hitherto known nothing of its capacity or attributes. The first sight of the object has no special interest to him. Why? Because these attributes of the iron, which become apparent on first notice, are not, by their nature, adapted to gratify or answer in any satisfactory way to any of the child's sensibilities. The color is in no special sense fitted to gratify his aesthetic sense; neither does its size, shape or weight gratify any sense of wonder; nor any pleasurable possibility of the soul. No one of these things makes any appeal to any aspirations of the soul; no one of them appeals to any sense of order in the universe; nor do they arouse any feeling of surprise nor any impression of novelty. So although these commoner attributes of the iron are known to the mind, and this same mind understands the capacities of itself, none of these attributes is for the moment calculated to start up any feeling of satisfaction or gratification. So there is as yet no interest felt in the magnet. But this piece of iron has not yet manifested all of its attributes, because as yet no condition has been fixed which would allow

or cause it to do so. Now place some iron filings on the table and pass the magnet near or over them. The magnetism then manifests itself as a power, drawing these filings to the magnet and causing them to adhere with considerable tenacity. Here is an attribute of the iron, which, by its own character, is fitted to minister to the wonder-loving sense of the child, to his innate love of order, to his fundamental notion of cause and effect, to his own feeling of personal power, and withal to his sense of pleasure in the unexpected, not having expected this power in so unpromising an object. This gratification of the wonder-loving propensity begins and a state of interest is soon developed. The feeling is wholly internal to the child; his self-gratification joined to expectancy, and extended outward and connected to the wonderful power of the magnet as its cause. The gratification of the capacities which are involved in the state of interest are mainly pleasures. Indeed, the pleasurable element is always present with expectancy in the true conditions of interest so far as this state of mind is available in education. It is in this respect to be carefully distinguished from those states of fear and terror which fix the attention and develop states of expectancy, but expectancy of other than pleasurable gratifications. In the true state of interest the continued action of the mind is solicited by the object whose attributes cause the expectation, and thus attention is caused through interest. Interest and attention thus react upon each other, each added degree of attention disclosing new attributes in the object, thus increasing interest, and each added degree of interest soliciting and holding greater attention.

Side by side with this emotional phase of interest, this gratification of the sensibilities, the enjoying of those attributes which give pleasure, there runs another stream of gratifications which is a little difficult to define and separate from the foregoing. This is the pure pleasure which always attends the proper action of normal and healthy faculties, whether physical or mental. This is the law of nature. An organ is a faculty that is made for a certain use: the eye is for seeing; the ear for hearing; the hand for handling; the muscle for contracting; the intellect for reasoning; sensibility for loving and hating; the will for deciding. Each power or faculty, physical or mental, has its appropriate function and is adapted to the doing of some special kind of action. There is an uplift to the spirit whenever it cognizes these powers accomplishing the things for which they are intended. Health, happiness, prosperity, the development and satisfaction of each power all lie in doing naturally, freely and fully that which it is adapted and intended to perform. The real pleasure to which I refer here is not always felt as connected with the organ exercised, but is the gratification of the spirit itself at successful action producing commensurate results.

Thus there are two factors which really make up the pleasurable element in the state of interest:

1. The answering of a felt need of the spirit when it has discovered some attribute of an object which answers directly or indirectly a felt need of the self.

2. The sense of satisfaction which the soul feels on finding powers or capacities normally exercised accomplishing intended results.

These two gratifications, supplemented by the state of expectancy which these develop—that the object under consideration, when further studied through these same capacities of the soul, will yield up other attributes which in their turn will gratify the soul—make up the complete state of interest. A state of enthusiastic interest has all three elements raised to a high degree. The interest of children rests about equally on all these sources. Every faculty of the child, his very muscles, eyes, ears, fingers, toes, intellect, sensibility, will, all are in such harmonious relation to one another and to his environment that each movement answers to an instinctively felt need of action, and every new element of knowledge serves a use in satisfying his capacity for enjoyment. In all competitive games the exercise is usually in itself agreeable because of its proper use of the organs and agencies; but the highest sense of pleasure, and hence the deepest interest, centers around the gratification of the ambition to excel, to conquer, to outdo others, to be first among one's fellows, this possibility being the native endowment of every healthy child, derived, no doubt, from the time when his remote ancestors struggled with the wild animals of the forest, vanquishing them by cunning when brute force was lacking. The boy's interest in the game lasts so long as the exercise in itself continues to give pleasure, or the object of enjoyment, victory—remains to lure him on. Both of these pleasurable elements in interest continue strong through early childhood and youth. They are characteristic of childhood. There is action for the sake of action. Action as pure enjoyment, is characteristic of infancy and childhood. Action for the sake of a purpose is a totally different thing, and is characteristic of later youth and manhood, in fact, the result of education and a mark of culture. It has no place whatever in the form of interest which I am now considering. In infancy action is even almost automatic. In most cases the action is stimulated by external forces. It occurs in response to outside stimulus without even conscious satisfaction. A need of the system is met, but not at first a felt need. The child as yet, therefore, has no interest. Soon, however, he awakes to the pleasure of action of both body and mind, and soon he becomes aware of the fact that action answers to a felt need of himself, is a method of self-expression, hence interesting, because gratifying. Soon this action of body and mind secures for him attributes of these objects,—food, rich colors, beautiful clothes, and the response to a felt need of the soul in these directions renders satisfaction. As this element increases, the interest in things through gratifying response which their attributes make to the soul, the actual enjoyment of mere action, while perhaps not growing less, is certainly becoming relatively less noticeable. At any rate, the enjoyment of the knowledge itself, as it answers to a need of the soul, is capable of so great development that it soon becomes a predominant element. Thus it is that we become interested in things, in the actions of others, and whatever furnishes attributes which serve our uses or give us pleasure. We may now be said to have interests. These things which furnish us satisfaction, with which we like to concern

ourselves, which attract us and solicit and receive our attention—attract us through the gratification which these things produce, and the expectancy of the continued gratification which they promise. In all this development of immediate interest, there is little conscious direction of effort toward an end or ideal, but rather spontaneous action of the whole soul on the inspiration of present satisfaction. There is no lapse of time between the action and the enjoyment of such action. In fact, the enjoyment is in the action itself. In the other case, there is no lapse of time between the appropriation of the attribute of the object, and the pleasure which such appropriation gives to the soul. The whole self is bound up in acts and enjoyments. The person has found himself, has expressed his immediate pleasure in this view of the attributes which have yielded him his natural satisfaction. When the number of things in which one thus feels an interest has enlarged through a more extended knowledge of things, the number of one's interests has correspondingly increased. It is manifest, therefore, that one's range of interests is somewhat definitely related to the scope of his knowledge. Since it is impossible that he should feel an interest in anything upon which he has never employed his powers, and whose attributes have never gratified any power of his mind, it therefore follows, so far as he extends his acquaintance with things, he enlarges the possibility of action, and he also enlarges the probability that he will discover more attributes which will furnish him enjoyment, that will increase the number of his interests, that he will find himself in harmonious touch with more and more elements of his environment, and thereby be enabled to live more richly, and to appropriate to his own gratification a larger share of the things of the universe.

Disciples of Herbart in this country have recently laid great stress upon this process of enlarging the range of interests as a part of education, to the end that the educated person may know life on many sides, thus becoming less dogmatical and more liberal, in fact, that he may be large minded, seeing things through the magnifying glass of a large and rich experience. The Herbartians have persistently advocated the doctrine of many-sided interest and diversity of interests. Through the exclusive devotion to this doctrine some of them have laid themselves liable to be charged with being narrow and dogmatic themselves. This estimate is largely due to the unwise and immature statements made by the Herbartians themselves, but chiefly, perhaps, to the narrow interpretation which they have made of the subject. In many cases the whole range of thought has been expended upon this narrow scope of immediate or native interest. It would seem sometimes, from this state of the case, as if the whole work of education were to be restricted to finding what will please the child at once, and then assisting him to satisfy his present propensities. A moment's reflection will show how utterly unworthy this view of education is. The very possibility of education itself lies in the power to create new ideals and therefore the capacity to develop new powers of enjoyment. With these new capacities come new possibilities of education in the discovery of attributes, which, while they do not at once gratify, most completely develop the powers of mind, or tend to answer the higher needs

of the soul. They are not at first so keenly felt, but are capable of being sensitized by education. Thus comes an opportunity of establishing new and higher objects of interest. It is true that modern civilization is chiefly the power to appreciate and use what is of no interest to the savage. The end of education is not to leave man a gratified savage but to develop him into a noble human being. Therefore, the lines of his interest must be changed, and the range of his interests enlarged. Thus it is not alone the business of the teacher to find what will interest the child, but rather to try to interest him in that which is worthy of his capacities and his destiny. Doubtless the process must begin with present interests, but it must terminate in the development of a line of interests which are human, which are worthy of an exalted being, born in the image of God, and capable of developing into fitness for association with noble presonalities. We must, therefore, look to something more than the gratification of early, or present interests. We must create new ones, must develop new capacities to appreciate, new possibilities of becoming interested in what is worthy in every province of human life and human endeavor. This looks to the development of an interest in a higher grade of attributes, or in the attributes of a higher grade of objects, whose attributes, when mastered, will gratify higher capacities of the soul. In other words, it teaches the child to create for himself ideals of a higher mode of life, and to take an interest in the adaptation of means to the realization of those ideals in a nobler sort of life. Interest in this new mode of life may become as strong and as overpowering as native interest, but its method of development and its law of operation are quite different. The kind of interest which I have thus far been describing is native, immediate, spontaneous. It wells up out of the spirit of the child like the waters of a copious fountain. It comes directly from the gratification which a thing gives to him, and centers itself upon the things whose attributes cause it. If a child should live his childhood and youth under the controlling force of interest of this kind, he would preserve his childlikeness and spontaneity, his happiness and his openness to truth. He would give his whole attention wherever his immediate interest might for the moment lead him. Whatever work he did under such influence would have much the character of play. He might, under its influence, become a great student, and even a great scholar, but hardly a great character. Something more than the influence of present interests is needed to develop strength and stability of character. This native interest is supreme in the childhood of the human being, but it will hardly serve as a proper training for youth and manhood. If one were always to remain a child, there could be nothing further needed than the development for the child intensely this native, immediate interest. Were there never any vicissitudes of life requiring the exercise of a higher virtue and a stronger application of will, there would be little need to develop interest of any higher sort. School education could then consist in making everything as attractive as possible, and all things requiring a real effort in study could be left off. This would, of course, result in no character, only animal life, spontaneous, irrational and unreasoning

life. But manhood and womanhood mean much more than this. They mean the development of character and will, making a thoughtful, manly or womanly person out of every child. For this we must look to a different kind of interest.

As has been stated in an earlier part of this paper, the things in which we may become interested are as numerous and diverse as the objects of the outer world, and of the inner world of mind, and of the institutions which our minds have created. But these classes of things differ widely in one respect, when viewed with reference to the development of interest in them, namely, that some of them interest us immediately because we find in them attributes which cause immediate satisfaction, gratifying powers that are already developed in us, and thus answering to a felt need of our souls. In this case we are interested in these objects as ends of study. Our interest in them is held by the satisfactions which they constantly give us. But there may be other objects that are in no wise interesting to us by reason of any present gratification which their attributes have for us. They do not answer any felt need of the spirit in themselves, but we discover on closer study of their relationships to ourselves that they may be made the means of reaching other things whose attributes do answer our needs, or will answer our needs when we have come into contact with them. Now, it may hardly be said that we at once develop an interest in these objects. It at first seems that we endure them because they are the means by which we reach objects that will interest us. It is the province of education to transform this endurance into a certain sort of interest, which will compel and hold the attention until the mind so masters these objects as to reach through them the objects which will interest the soul through their attributes. This often requires that selected attributes from objects already known to be woven together in memory and thrown upon the canvas of the future in the form of an ideal. The ideal condition, when realized, will furnish attributes which gratify, but the objects which must be used as the means of the realization of this ideal may not gratify the soul which used them. The steps by which one learns to hold his interest in the uninteresting because he has discovered a new relationship of this to the use of his soul is the process of transforming the simple, innocent, irrational, physically active, mentally volatile, child into an intelligent, rational, cultivated person; and between these two extremes lies the large range of our daily teaching, with its necessary deficiencies, its temporary defeats, its final victories; much of it unconscious effort and unconscious tuition, but, as a whole, directed by a more or less well understood philosophy of education.

I know that it is a favorite theory of many that all that is needed is a little time for the child to grow into a cultivated person, that the school should rather be made a place of detention during the growing period. Without ignoring pleasure as a factor, it is sufficient to notice that grown up children are not much superior to young children; but what we need rather is a type of man or woman capable of coping with the growing complexity of modern life. It is true that pleasure is salutatory in its

effect, but its best results accrue only to those who, besides obeying the physical conditions and laws of life, live in the environment of institutions, in exalted companionship with noble human natures, under restrictions which are little appreciated and less liked by the uncultivated man. In other words, the course of education includes the necessary training in the knowledge of communities, in the knowledge of the beneficence of human institutions, the necessity of law and order in the community and self-controi in one's self, none of which the savage man in any fair sense appreciates, and many of which are mere means to higher ends. It is thus a large part of education to acquaint the pupil with his spiritual environment, the order of civilization in which he is born, to acquaint him with the immense worth of his spiritual influence, and thus to build up within him a standard of life in harmony with his nature and destiny.

To live up to the high standard of life here outlined, in the midst of a civilization still holding many of the crudities and evils of savage life requires that each of us shall daily do many things which in themselves are not only not pleasurable but which are positively distasteful. In and of itself much of our work is pure drudgery, while much of it requires us to bear large responsibilities, to endure petty annoyances, and to do disagreeable things. It is impossible that we should feel real interest in these things by reason of any gratification of any power of ours by any original attribute of theirs. There is therefore no motive to do these things unless one can be found elsewhere but so related to these acts as to constitute for the time being a valid vicarious interest. The end sought must not only justify but also glorify the means. The contemplation of the ideal end must give a pleasure akin to that felt in its realization, in order that this pleasure shall accompany the doing of the drudgery, gliding at last into the glorious realization of the end achieved by the dull drudgery, till the mind scarcely any longer distinguishes the limits of each and the whole is fused into one glorious sense of achievement. This transformation is complete when this attribute—the relation of means has been clearly seen and the means has accomplished the longed-for end; then the means itself—though it be drudgery—is now loved for one of its own attributes—this very capacity to achieve desired ends—then is *immediate* interest in the means itself developed in place of vicarious or mediate interest.

Happy is he in life who can so live that the effulgent glory of his ideal life is thrown backward till it lights up all the pathway of his actual life. His ideal is the magnet pole of his life. He will drudge for ten hours per day if need be in order that he may found his ideal family life and keep it sweet and pure under the shadow of his own vine and fig tree. He will march with steady step to the cannon's mouth, at the call of his patriotic ideal, counting life and limb as mere incidents in the series of movements by which civil and religious liberty are established. He will council together with his neighbors, foregoing his personal preference to the end that the social order may be unbroken. His interests are so set in the best things that he cannot stoop to the mean or low; and the fine sense of gratification coming from the realization within himself of a high

grade of manhood compensates for laborious efforts and frequent disappointments in external purposes. The perfection of culture is to think clearly, to aspire nobly, to drudge cheerfully, to sympathize broadly, to decide righteously and to perform ably. The undeveloped child can do none of these things. The undeveloped germ of the possibility to do these things is his by native endowment. The province of eduation lies between these two extremes. To understand the philosophy of education we must study the child as he is, to get our point of starting. But we must study the possibilities of man, as he has expressed himself in history, literature, art and achievement, to get the other point which sets our trend and gives direction to our educational effort.

FRENCH SECTION

TO WHAT ACCOMPLISHMENT SHOULD THE TWO YEARS' COURSE IN HIGH SCHOOL BE DIRECTED?

HELEN FARRAND NAUMANN, PORT HURON.

In arranging a plan for French work in high schools two groups of pupils must be considered. First: those fitting themselves for entrance to a university, and second: pupils whose systematic training will end with their high school course. The former must be well provided for, or a school can claim no place on the "diploma list," while the best interests of the latter, constituting the majority in each class, should be equally our care. This diversity of purpose on the part of students, however, presents to my mind no added difficulty. For I would instruct both classes of pupils in exactly the same way. Not that the same method could be advantageously employed in the lower grades, or outside of schools in many instances. Immaturity of mind in the one case, and a lack of adequate technical preparation in English in the other would render the adoption of such a course unwise. But to those who have entered the high school after thorough work in the lower grades grammatical terms should be perfectly familiar, logical presentation of grammatical principles intelligible, and, in general, the grammatical path to the fair land of France in speech and literature the most direct one. But I would make this path a broad and beautiful avenue, well provided with all that can render the journey pleasant, relieve fatigue, and prevent monotony, while not detaining the traveller too long nor deflecting his steps.

My conviction that even those high school pupils not contemplating a university course should be trained on strictly scientific lines, is based

upon personal observation and experience. I have seen the efficacy of various methods practically tested on French soil. For greater clearness, I will separate into four classes those American students of French whom I have observd abroad.

I. Those with *no* previous knowledge of French.

II. Victims of the exclusively "conversational" method.

III. Students who had pursued the laborious course formerly traversed in studying ancient languages.

IV. Those who, with careful study of grammatical principles, had acquired an ability to apply such principles through systematic drill in conversation, dictation, composition, etc.

I have noted that beginners soon overtake those instructed in America by the conversational method exclusively, and that students possessing only theoretic knowledge find themselves utterly helpless regarding the spoken language. On the other hand, the results of a course of study furnishing a thorough elementary knowledge of grammar strengthened by constant practical application are in the highest degree satisfactory. A few weeks' stay in Paris then suffices to equip the student with a supply of words and phrases adequate for all needs, whether his aim be science, art, or general culture. Each acquisition finds its allotted place, all resting on a firm and broad foundation.

It is true that only a small proportion of our students will test their knowledge of French in Paris. But it will be conceded that what best prepares one for further study or social intercourse in France constitutes likewise the best preparation for any later use of the language.

Since the claims of grammar for an important place in our course have been now presented, it remains to be considered what should be the scope of work in this line. In my opinion, we must limit ourselves to the essential, the eminently practical, while taking care that our foundation be fitted for permanency. Historical grammar, and syntactic intricacies should be reserved for later study, even in longer courses. In the two years' course, lack of time would prevent their introduction; but aside from this, inaccuracy and timidity of memory often result from too early invasion of these grammatical provinces. This reflection would not preclude, however, the occasional explanation of a derivation (especially useful to Latin pupils as an aid to correct orthographic accent) or the notice of English-French cognates. Such observations tend to increase interest, and prove to pupils the correlation of their studies—an important point.

The choice of a text-book in grammar is a serious thing, even though it be used simply as a manual. With eagerness I examine each new aspirant for honors in this field that reaches me, only to lay it down with that feeling at my heart occasioned by "hope deferred." With due appreciation of admirable points in many new grammars, I have not yet seen what seems to me the ideal book for English speaking pupils. A thought expressed in a recent article on modern architecture might find an application here, in many cases:—"Architects now originate simply for the sake of novelty, not in order to produce something better, but merely something unfamiliar."

My objection to most of the new grammars is that their plan is not sufficiently scientific. They do not furnish the foundation required by all varieties of students. Other text-books with excellent plan omit any presentation of French equivalents for grammatical terms, thus necessitating the consumption of much extra time in case French is to be largely the language of the class-room.

Of the grammars with which I am acquainted, I prefer Whitney's as a text-book for beginners, owing to its logical presentation of most of the essential principles, and its systematic arrangement. Retaining its frame work, the material parts may be adapted and elaborated to suit one's own ideas. In my opinion, an equivalent to Part I. of this grammar furnishes sufficient knowledge of principles for our course. The eight long years spent on French grammar in the schools of Germany do not produce the practical results that would satisfy me as a teacher, and such drudgery may engender great distaste for the subject. Who knows but that in the irksomeness of this eight years bondage to "dem Kleinen und dem grossen Ploetz" may lie the hidden cause of many a modern German's lack of love for his French brother? But a genuine "Prussian drill" in grammatical forms and fundamental rules cannot be dispensed with in any thorough course.

All knowledge of rules or of word-forms, however, avails little without a reliable vocabulary. The most skillful cook cannot make bread without flour. Therefore, an absolute *possession* of the most commonly used words should be one of our requirements. To stimulate endeavor, and accomplish accuracy in this regard may be recommended an occasional "vocabulary down," conducted on a plan similar to that of the old fashioned "spell-down." In my experience, this exercise rather saves than consumes extra time in the end, and "idiom-downs" form another profitable pastime for pupils somewhat advanced.

The entrance requirements of our state university most wisely emphasize a practical knowledge of French rather than the reading of a long list of texts. I speak feelingly on the subject of text-lists, for the diversity of those required for entrance into various colleges has repeatedly caused me great perplexity. In gathering data for a paper presented by me at a conference held at Chicago University a few years ago, I ascertained that if, in a class of four, each member were preparing for one of four certain colleges respectively, the class would be obliged to read twenty-seven different texts, to say nothing of other class work. A special list of texts for the two years' course seems to me inexpedient, although the reading should be confined to modern authors, and might well include a comedy. Quality and not quantity of work in reading is our most important consideration. Translating into English, moreover, is a matter that almost takes care of itself. It has a place in every good course, and its usefulness is apparent. But, with many instructors, far too much time is devoted to it. Only on rare occasions is it necessary to require the translation, in class, of a review lesson. Its substance may be narated by pupils consecutively in well-rounded French sentences, or may be reproduced in answer to questions from the

instructor, or from pupils in turn. Conversation among students in class by way of query and answer may well begin as soon as one tense of the first verb has been learned, in addition to a few nouns. Pupils are delighted at the achievement of these first tottering steps, and as surprised as was Molière's M. Jourdain when he discovered that he could talk prose. These slight successes also bring confidence, a most important aid in acquiring a foreign tongue, particularly in the case of boys and girls of high school age—that period of blushing and stammering self-consciousness. This same self-consciousness is the most formidable hindrance to correct pronunciation. There are individuals in every class who must be drilled by themselves. They are never willing to risk possible ridicule by attempting to roll an "r" or to produce one of the nasal sounds in the presence of classmates untill such feats have become quite safe and easy. In these private rehearsals I have more than once discovered a "star-pupil," thus reaping a speedy reward for my extra labor. Each correct enunciation of a French sound, each correct utterance of a French expression, is a firm step in advance, for our vocal organs, no less than our brains, are wondrously influenced by habit. The difficulty in securing sufficient practice of this kind in large classes may be met by concerted repetition, sometimes with closed books, and even with closed eyes, in order to insure complete attention to sound.

Thus, step by step, our student acquires the ability to pronounce correctly and fluently even in sight-reading, as well as to recognize readily French words and expressions when spoken. Dictation exercises become a pleasure, and confidence in himself brings increased zest for further study.

In composition work, which should be one of the prominent features of our plan, modern methods have produced a most valuable change, and what was often drudgery in former years has become an agreeable task. No longer does the student dread composition days. In fact, repeatedly individual pupils have requested me to oversee extra work in this line, asserting that "it is so much fun to write the exercises." If, immediately upon the acquisition of barely sufficient material, the student is required to write original sentences during the recitation period—a little privilege that I often attach to the speedy completion of assigned work—or to prepare illustrative expressions as part of his work in learning idioms, a beginning of composition work is made, and the transition to connected sentences follows naturally. In my monthly tests, after the first few weeks, all questions are expressed in French, and not one English word appears in the answers to these questions, or, in fact, on any examination paper from the beginning of work. I require no translation from French into English in any examination.

To one who regrets the present rareness among students of an old-fashioned memory, it is gratifying to note the growing encouragement given to memorizing choice bits of French verse. The importance of this exercise should exact a definite place for it in our plan of work. It has long been my custom to have second year pupils memorize with distributed parts whole acts from some modern comedy read by them. This never fails to interest a class, and the results are always more than satisfactory.

What may we then secure by the two years' course? I answer: A correct and fluent pronunciation, together with a readiness in recognizing French spoken words; a good working vocabulary and acquaintance with common idioms; the ability to translate, into or from French, language of ordinary difficulty, and to write easy French off-hand; and a practical knowledge of grammatical principles. To these items should be added a cursory acquaintance with France, her life and literature.

Moreover, without losing sight of our aim, we must not fail to awaken and maintain on the part of students a keen interest in their work. When interest flags, progress is slow and awkward. To popularize the study of French, to increase the number of pupils pursuing it is by no means the least important part of our task. Fortunately for us, language work may be presented in endless variety if we choose to avail ourselves of its possibilities.

MATHEMATICAL SECTION

REPORT OF THE BRITISH ASSOCIATION COMMITTEE ON THE TEACHING OF ELEMENTARY MATHEMATICS.

PROFESSOR W. W. BEMAN, UNIVERSITY OF MICHIGAN.

The report of the British Association Committee on the Teaching of Mathematics, as presented by its Chairman at the Belfast meeting in 1902, is as follows:

In submitting their present report, the committee desire to point out that this is not the first occasion on which the British Association has attempted to deal with the teaching of elementary mathematics. About thirty years ago, a similar body was appointed to consider a part of the subject, viz., "the possibility of improving the methods of instruction in elementary geometry," and two reports were presented, one at the Bradford meeting in 1873 (see the Report volume for that year, p. 459), the other at the Glasgow meeting in 1876 (see the Report volume for that year, p. 8).

The two reports advert to some of the difficulties that obstruct improvements in the teaching of geometry. One of these is alleged to be "the necessity of one fixed and definite standard for examination purposes"; apparently, it was assumed that this fixed and definite standard should not merely be required from all candidates in any one examination, but also be applied to all examinations throughout the country. In order to secure the uniformity thus postulated, the committee thinking that no text-book had been produced fit to succeed Euclid in the position of authority, and deeming it improbable that such a book could be produced by the joint action of

selected individuals, suggested the publication of an authorized syllabus. In their second report they discussed the merits of a particular syllabus—that of the Association for the Improvement of Geometrical Teaching; but, in spite of such commendation as was then expressed, the syllabus has not been generally adopted.

It is still true that (in the words of the former Committee) "in this country at present teaching is guided largely by the requirements of examinations." For some time to come, the practice of the country is not unlikely to allow examinations to retain at least a partial domination over teaching in schools. Accordingly, it seems to be a preliminary requisite that examinations should be modified; and, where it is possible, these modifications in the examinations should leave greater freedom to the teacher, and give him more assistance than at present.

On the other hand, there is a tendency in this country whereby, in such matters as teaching and examination, the changes are only gradually effected, and progress comes only by slow degrees. Accordingly, the general recommendations submitted in this report are such that they can be introduced easily and without any great alteration of the best present practice. It is the hope of the Committee that the recommendations, if adopted, will constitute merely the first stage in a gradual improvement both of teaching and of examinations. For the most part only broad lines of change are suggested; this has been done in order to leave as much freedom as possible to teachers for the development of their methods in the light of their experience.

IS UNIFORMITY IMPERATIVE?

The Committee do not consider that a single method of teaching mathematics should be imposed uniformly upon all classes of students, for the only variations then possible would be limited by the individuality of the teacher. In their opinion, different methods may be adopted for various classes of students, according to the needs of the students, and corresponding types of examinations should be used.

It is generally, if not universally, conceded that a proper training in mathematics is an important part of a liberal education. The value of the training depends upon the comprehension of the aims of the mathematical subjects chosen, upon the grasp of the fundamental notions involved, and upon the attention paid to the logical sequence of the arguments. On the other hand, it is freely claimed that, in the training of students for technical aims such as the profession of engineering, a knowledge of results and a facility in using them are more important than familiarity with the mathematical processes by which the results are established with rigid precision. This divergence of needs belongs, however, to a later stage in the training of students. In the earliest stages, when the elements of mathematics are being acquired, the processes can be substantially the same for all students; and many of the following recommendations are directed towards the improvement of those processes.

TEACHING OF PRACTICAL GEOMETRY.

The former Committee recommended (and the present Committee desire to emphasize the recommendation) that the teaching of demonstrative geometry should be preceded by the teaching of practical and experimental geometry, together with a considerable amount of accurate drawing and measurement. This practice should be adopted, whether Euclid be retained, or be replaced by some authorized text-book or syllabus, or if no authority for demonstrative geometry be retained.

Simple instruments and experimental methods should be employed exclusively in the earliest stages, until the learner has become familiarized with some of the notions of geometry and some of the properties of geometrical figures, plane and solid. Easy deductive reasoning should be introduced as soon as possible; and thereafter the two processes should be employed side by side, because practical geometry can be made an illuminating and interesting supplement to the reasoned results obtained in demonstrative geometry. It is desirable that the range of the practical course and the experimental methods adopted should be left in large measure to the judgment of the teacher; and two schedules of suggestions, intended for different classes of students, have been submitted to the Committee by Mr. Eggar and Professor Perry respectively, and are added as an Appendix to this Report.

SHOULD THERE BE A SINGLE AUTHORITY IN GEOMETRY?

In the opinion of the Committee, it is not necessary that one (and only one) text-book should be placed in the position of authority in demonstrative geometry, nor is it necessary that there should be only a single syllabus in control of all examinations. Each large examining body might propound its own syllabus, in the construction of which regard would be paid to the average requirements of the examinees.

Thus an examining body might retain Euclid, to the extent of requiring his logical order. But when the retention of that order is enforced, it is undesirable that Euclid's method of treatment should always be adopted; thus the use of hypothetical constructions should be permitted. It is equally undesirable to insist upon Euclid's order in the subject-matter; thus a large part of the contents of Books III. and IV. could be studied before the student comes to the consideration of the greater part of Book II.

In every case, the details of any syllabus should not be made too precise. It is preferable to leave as much freedom as possible, consistently with the range to be covered, for in that way the individuality of the teacher can have its most useful scope. It is the competent teacher, not the examining body, who best can find out what sequence is most suited educationally to the particular class that has to be taught.

A suggestion has been made that some Central Board might be instituted to exercise control over the modifications made from time to time

in every syllabus issued by an examining body. It is not inconceivable that such a Board might prove useful in helping to avoid the logical chaos occasionally characteristic of the subject known as Geometrical Conics. But there is reason to doubt whether the authority of any such Central Board would be generally recognized.

Opinions differ as to whether arithmetical notions should be introduced into demonstrative geometry, and whether algebraic methods should be used as substitutes for some of the cumbrous formal proofs of propositions such as those in Euclid's Second Book; for opinions differ as to the value of strictly demonstrative geometry, both for training and for knowledge. Those teachers who do not regard algebraic methods as proper substitutes for geometric methods might still use them, as well as arithmetical notions, for the purpose of illustrating a proposition or explaining its wider significance. It is the general opinion of the Committee that some association of arithmetic and algebra with geometry is desirable in all cases where this may be found possible; the extent to which it may be practised will depend largely upon the individual temperament of the teacher.

Every method of teaching demonstrative geometry has to face the difficulties inevitably associated with any complete and rigorous theory of proportion. In the opinion of the Committee, not merely is Euclid's theory of proportion unsuited for inclusion in elementary work, but it belongs to the class of what may be called university subjects. The Committee consider that the notion of proportion to be adopted in a school course should be based upon a combination of algebraical processes with methods of practical geometry.

EXAMINATIONS IN GEOMETRY.

As regards examinations in geometry, the Committee consider that substantial changes in much of the present practice are desirable. In most, if not in all, of the branches of mathematics, and especially in geometry, the examination ought to be arranged so that no candidate should be allowed to pass unless he gives evidence of some power to deal with questions not included in the text-book adopted. Such questions might comprise riders of the customary type, arithmetical and algebraical illustrations and verifications, and practical examples in accurate drawing and measurement. The Committee consider the latter of particular importance when the range is of an elementary character; some influence will be exercised upon the teaching, and some recognition will be given to the course of practical geometry that should be pursued in the earlier stages.

ARITHMETIC AND ALGEBRA.

The Committee are of opinion that, in the processes and explanations belonging to the early stages of these subjects, constant appeal should be made to concrete illustrations.

In regard to arithmetic, the Committee desire to point out what has been so often pointed out before, that, if the decimal system of weights and measures were adopted in this country, a vast amount of what is now

the subject-matter of teaching and of examination could be omitted as being then useless for any purpose. The economy in time, and the advantage in point of simplification, would be of the greatest importance. But such a change does not seem likely to be adopted at present, and the Committee confine themselves to making certain suggestions affecting the present practice. They desire, however, to urge that teachers and examiners alike should deal with only those tables of weights and measures which are the simplest and of most practical use.

In formal arithmetic, the elaborate manipulation of vulgar fractions should be avoided, both in teaching and in examinations; too many of the questions that appear in examination papers are tests rather of mechanical facility than of clear thinking or of knowledge. The ideas of ratio and proportion should be developed concurrently with the use of vulgar fractions. Decimals should be introduced at an early stage, soon after the notion of fractions has been grasped. Methods of calculation, accurate only to specified significant figures, and, in particular, the practice of contracted methods, should be encouraged. The use of tables of simple functions should be begun as soon as the student is capable of understanding the general nature of the functions tabulated; for example, the use of logarithms in numerical calculation may be begun as soon as the fundamental law of indices is known.

In regard to the early stages of algebra, the modifications (both in teaching and in the examinations) which are deemed desirable by the Committee are of a general character.

At first, the formulæ should be built on a purely arithmetical foundation, and their significance would often be exhibited by showing how they include whole classes of arithmetical results. Throughout the early stages, formulæ and results should be frequently tested by arithmetical applications. The arithmetical basis of algebra could be illustrated for beginners by the frequent use of graphs, and the practice of graphical processes in such cases can give a significance to algebraical formulæ that would not otherwise be obtained easily in early stages of the subject.

In passing to new ideas, only the simplest instances should be used at first, frequent reference still being made to arithemetical illustrations. Advance should be made by means of essential development, avoiding the useless complications of merely formal difficulties which serve no other purpose than that of puzzling candidates in examinations. Many of the artificial combinations of difficulties could be omitted entirely; the discussion of such as may be necessary should be postponed from the earlier stages. Teachers and examiners alike should avoid matters such as curious combinations of brackets; extravagantly complicated algebraic expressions, particularly fractions; resolutions of elaborate expressions into factors; artificially difficult combinations of indices; ingeniously manipulated equations, and the like. They have no intrinsic value or importance; it is only the mutual rivalry between some writers of text-books and some examiners that is responsible for the consideration which has been conceded to such topics.

GENERAL REMARKS.

If general simplification either on these or on similar lines be adopted, particularly if graphical methods are freely used, it will be found possible to introduce, quite naturally and much earlier than is now the case, some of the leading ideas in a few subjects that usually are regarded as more advanced. Thus the foundations of trigonometry can be laid in connection with the practical geometry of the subject-matter of the Sixth Book of Euclid. The general idea of co-ordinate geometry can be made familiar by the use of graphs, and many of the notions underlying the methods of the infinitesimal calculus can similarly be given to comparatively youthful students long before the formal study of the calculus is begun.

ON THE RELATION BETWEEN MATHEMATICAL RESEARCH AND SECONDARY INSTRUCTION.*

PROFESSOR E. R. HEDRICK, UNIVERSITY OF MISSOURI.

I consider it a great privilege to address the Michigan Schoolmasters' Club, and particularly upon a subject of such import. The breadth of the topic is so great, however, that I feel myself quite unable to do more than point out a few of the many questions which naturally arise, and suggest to you the advisability of their serious consideration. That I should attempt to pass final judgment upon matters of such difficulty, would indeed be presumptuous; my only regret is that I cannot be present in person to learn the views of you who come into such direct contact with the practical side of the questions of which I am to speak.

That the enormous strides made in the study of pure and applied mathematics in the last score of years, must eventually react upon the instruction in the elementary mathematics of the secondary schools and of the first two years of college, seems certain. Just what effect this reaction will have upon such instruction is now very problematical; and without careful consideration and coöperation on the part of earnest teachers throughout the country, the good effects, to which we may reasonably look forward, may be long delayed, or rendered temporarily abortive. On the other hand, it is of vital importance that intelligent teachers should guard against the tendency to overdo any attempted reform, and see that its force is not lost in "fad-isms".

It is for these two reasons that I wish to suggest and explain the following tentative propositions relative to the teaching of mathematics in high schools and in the first two years of college. I sincerely trust that their promulgation will fix attention upon the subject, and that it will provoke a most lively criticism. I would then suggest:—

*Read by Professor Beman, in the absence of the writer.

(1°) That an effort be made to appreciate and to apply in elementary teaching, the results of modern research in pure and applied mathematics;

(2°) That to this end, to avoid overdoing the matter, the teacher himself should attempt to master those features of the subject which apply to elementary teaching; but that the effect upon the student should be left to the unconscious influence of the teacher's improved points of view, rather than that any radical departures be made immediately, from the material actually taught at present, or from the present methods of instruction;

(3°) That more attention should be paid, however, to the physical and other applications of the subjects taught; and that the various branches should be brought into much closer correlation, or, in certain cases, actually intermingled with one another:

(4°) That a system of laboratory instruction, on a very modest scale, should be introduced gradually; and that boards of education and others instrumental in the arrangement of curricula, be impressed that the advantage to be derived from mathematical exerices over pure class-room drill, is equal to the enormous advantage recently realized in the instruction in physics and chemistry, by the general introduction of laboratory instruction in those subjects;

(5°) That the requirements for admission to college be adapted so as to foster, or at least so as to permit of, such changes in instruction; preferably by the adoption of alternate requirements, which could be satisfied by either method of instruction.

In the discussion and explanation of these theses, it will be enlightening to consider for a moment the history of mathematics in America.

Prior to 1875, aside from one or two illustrous examples, including at least Benjamin Peirce, the advances made on the continent of Europe in the study of pure mathematics, were practically unkonwn, or neglected, in this country. Up to about this time, original work in mathematics by Americans was almost unheard-of, and the knowledge of that done by foreigners was far from general, even among men in the highest position in the American mathematical world.

After about 1875, due to the increasing prosperity and settled condition of the country, more attention began to be paid to the purely scientific side of mathematics, and such a movement, once inaugurated, necessarily bore the fruits of its own logical justification. Today, contrasted with the condition of mathematical knowledge in America in 1875, the situation can fittingly be described as phenomenal and phenomenally encouraging. In almost every large university in the country, and in surprisingly numerous smaller colleges, men are to be found, in ever increasing numbers, whose whole lives are consecrated to the development of pure and applied mathematics; and whose original contributions to the theory commence to be of no mean order, even when compared with the productions of the schools of continental Europe, backed by their hundred years of standing—for modern mathematics is now practically in the beginning of its second century. That these men appear otherwise normal, sane, and appreciative of other sciences, and that they are surely not working for pecuniary gain, leads us to feel

that behind the veil of apparent uselessness and impracticability, must lie an enchanting field of actual reality and fruitfulness, which charms them to their self-imposed tasks, and inspires them in their work.

The American Mathematical Society, non-existant in 1887, now has over four hundred members, bound in a union of fraternity and of enthusiastic sympathy, which no scientific society, at home or abroad, can surpass. This society now publishes two journals, the *Bulletin*, and the *Transactions*, which are recognized, even in Europe, to be among the leading mathematical journals of the world. And at least two other mathematical journals of excellent reputation are published in this country: the *American Journal of Mathematics*, published by Johns Hopkins University; and the *Annals of Mathematics*, published by Harvard University. What is of more consequence, the papers published by these journals are, almost exclusively, the productions of American mathematicians—teachers in our schools and colleges.

Such is, in brief, the history of mathematics in America during the last thirty years, constantly increasing in volume and importance; the last fifteen years cover the history of the American Society; while only in the last five years have the courses in instruction in higher mathematics in our Graduate Schools approached anything like equality with the work in Germany, France, and Italy. It is therefore not surprising that modern mathematical research has not as yet generally affected the elementary instruction in mathematics in American secondary schools; but the time is surely ripe for the serious discussion of this inevitable result.

I propose to discuss briefly a few of the points at which recent investigation touches upon elementary instruction; and, in doing so, I shall make use of ideas which are already prevalent abroad, and of various papers which have recently appeared in American and in European journals, treating the subject of elementary mathematical instruction from a similar standpoint.

Among the questions which arise, the discussion of the axioms underlying geometry and algebra has recently attracted the most widespread attention. I do not agree with those enthusiasts who would force upon the unprepared mind of the young student, ideas of such comparative complexity as those at the basis of these discussions. But it does seem fitting that the *teachers* of mathematics should know and appreciate the excellent work recently done on these subjects, to the end that the teachers themselves be not ignorant of the present state of knowledge, and that they may be able to avoid the formation of wrong conceptions in the minds of the pupils. This can all be done, and without changing the *form* of instruction at all; for, while the matter is not suitable for direct presentation to the student, it is perfectly possible for an intelligent teacher, even though his mathematical education has been restricted to the most elementary college courses, to so familiarize himself with the essential ideas as to avoid forms of expression which would induce wrong conceptions in the student's mind. The study of the axioms of mathematics, in its modern conception, probably started with Gauss, in Germany, about 1800. It was he, and his followers, who showed conclusively the impossibility of proving the axiom of parallels from the

other axioms usually assumed. Even this work was not completed, however, until the middle of the century. The existence and the logical character of geometries in which the Euclidean axiom does *not* hold, and the application of such studies to highly practical problems, are still fruitful subjects of investigation.

But it is even more recently that the greatest light has been thrown on the subject of the axioms of mathematics, and their real significance. Beginning with the work of Pasch, in Germany, and Veronese, in Italy, this newer view found its most brilliant exposition in the now famous treatise on the foundations of geometry*, published in 1900, by Hilbert, in Germany. This book is now fortunately available in English, in a fair translation**; and it should be in the hands of every sincere teacher of geometry—not for his pupils, for they cannot understand its true meaning, but for the teacher's own guidance and information. In obtaining the English translation, the list of corrections, now in preparation, should be secured.

The purposes of such work cannot be explained hastily; it is necessary for one to study in private these apparently trivially simple developments, and to try to discover the real reason for the enormous importance which is now universally attached to them. Let me mention a few points which are now accepted as fundamental canons.

(1°) *The logical consequences of a set of axioms are theorems, which must hold for any set of "things" for which the axioms themselves hold.*

(2°) *In a logical proof, no appeal whatever can be made to the intuition, since the theorems do not depend on the nature of the "objects" employed, except in that the axioms are satisfied.* But *in elementary instruction* intuition should be employed *constantly*: the only thing desired is that the *teacher himself* should not lose sight of the nature of a *proof, in a strictly logical sense.* That assumptions made in elementary instruction are quite allowable, will be seen from No. (5).

(3°) *The only absolutely necessary characteristic of a set of axioms is that the statements made shall in no wise* CONTRADICT *one another.* To show that a given set of axioms does not contradict itself, a *proof* is necessary, since we have no means of judging directly; and this proof is usually very difficult. *Still no proof should be given to the student.* But the *teacher himself* should try to grasp the proof given by Hilbert, that *the ordinary axioms of ordinary geometry are*, in this sense, *compatible.*

(4°) *It is further desirable (but in no sense a logical necessity) that the set of axioms assumed should* (a) be as *simple* as possible, (b) contain as few *redundancies* as possible, (c) correspond with reasonable accuracy to our *ordinary* conceptions and ordinary intuitive ideas, derived from experience.

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*D. Hilbert, *Grundlagen der Geometrie*, Leipzig, Teubner, 1899, 8 vo., 92 pp.

**D. Hilbert, *The Foundations, of Geometry*, Translated by E. J. Townsend, The Open Court Publishing Co., Chicago, 1902, 8 vo., 132 pp.

(5°) *It is permissible, in elementary instruction, to introduce* AS AN AXIOM *any statement whatever, which can be proved from the other axioms assumed, i. e., any theorem; or indeed any other statement which does not contradict the original set of axioms, whether or not it is a consequence of them.* This seemingly revolutionary statement is surely justified in the light of these researches, and it should be made clear to every teacher of mathematics. The teacher should of course use proper judgment in assuming theorems in this way without proof, and he should convince *himself*, of course, that the assumptions *are* theorems, or at least, that they are compatible with the axioms. Otherwise their assumption is justifiable on exactly the same grounds as is the omission of the general proof of compatibility.

(6°) *An axiom is by no means a "self-evident truth," nor a "proposition which cannot be demonstrated".* The first of these usual statements corresponds to the notion that intuition is infallible; the second asserts that the system used is entirely free from redundancies. The teacher should realize that *an axiom is merely an arbitrary assumption, which can be altered at the will of the operator;* and that *a set of axioms is any set whatever of such arbitrary assumptions, whose sole necessary characteristic is their compatibility.* We choose from all possible sets, for purposes of elementary instruction, one which is *simple*, and which *corresponds to a reasonable extent with our rough conceptions* gained from necessarily crude experience, for the science under discussion. Care is necessary, logically, only in the proof that the axioms are compatible.

But it is not intended that this short paper should form any complete exposition. The reasoning which leads to the above facts must be carefully gone through before one can render an intelligent judgment. I shall be satisfied if I have directed attention to the subject: for, while the bald statements are at times startling, they are the inevitable result of any thoughtful and intelligent consideration.

I would mention, as enlightening upon the whole question, besides the work already referred to, the following books and papers, which should be in every college library, and accessible to teachers generally:—

Karl Pearson, *The Grammar of Science*, second edition, London, Black, 8 vo., 548 pp.

B. A. W. Russell, *The Foundations of Geometry*, Cambridge University Press, 1900, 8 vo., 201 pp.

Ernst Mach, *The Science of Mechanics*, translated by T. J. McCormack, Open Court Co., Chicago, 1893.

E. H. Moore, *The Foundations of Geometry*, Trans. Am. Math. Society, Vol. 3, 1902.

E. H. Moore, *On the Foundations of Mathematics* (Presidential Address), Bull. Am. Math. Society, Vol. 9, No. 8, May, 1903.

In the perusal of these books and papers, the earnest reader will find many references to other literature, which will prove of great interest, especially if he has a reading knowledge of foreign languages.

But this is merely one point of contact; and there are many others of equal interest, and of equal importance to the teacher in avoiding the installa-

tion of what I might call *false truth* into young minds—truths which require much explanation to make them convey a truthful impression; falsehoods disguised in a cloak of intuitive fallacy.

The question "What is a curve?" is, for example, a much more interesting one than appears on the surface. It is extremely easy to see that a curve cannot, in general, be regarded as the "path of a moving point". While it is best to give some such definition to the young student, it is surely advisable for the teacher, if possible, to familiarize himself with the demonstrated facts, of which I may mention a few:*

(1°) *There are continuous smooth curves which have no tangents at any points; such curves cannot be generated by motion as ordinarily conceived.* It is perhaps even more remarkable that curves exist which *have* tangents at an infinite number of points in any portion, no matter how small, but which *lack* tangents at an infinite number of other points in the same portion. But such curves may have a length.

(2°) *Curves exist which have tangents at every point, and which have no corners, but which have no curvature, no radii of curvature, and no centers of curvature, in any sense whatever.*

(3°) *There are curves which are continuous at an infinite number of points in any portion, no matter how small, but which are discontinuous at an infinite number of other points in the same portion.* Such curves, if plotted in the ordinary manner, would appear to be perfectly smooth, in many cases.

(4°) *There are curves which one can cross without cutting.*

(5°) *There are continuous curves which entirely fill an area.* For that matter, it would be equally easy to construct a curve which entirely fills a portion of space.

This list is not, of course, intended to be complete in any sense, but is merely intended to give a rough idea of the remarkable results to be found in this field. The teacher who feels interested will find an abundance of literature on the subject, in the recent volumes of the journals which have been mentioned; and many references to foreign books and periodicals will be found in these papers themselves.

Again, in the definition of such words as "*motion*", "*congruence*", and "*length*," the most careful consideration is necessary. That "a straight line is the shortest distance between two points", is, for example, a statement whose apparent simplicity covers a multitude of fallacies. For the young student, it is indeed best to give such definitions, faulty though they may be, and to treat motion as a preconceived idea. But it is clearly of importance to the *teacher* to make clear to himself the complex relations existing between these three concepts. Logically, it would perhaps be best to define congruence first, and then to define motion and length in terms of congruence. But whichever order is selected, care must be taken to avoid the use of one of these terms in defining another of them, before it itself has been defined. That this is not usually done, will be apparent from the most hasty examination of the definitions ordinarily given; and it is doubtless *best* to pass over the subject with more or less intuitive explanations, in pre-

*The author regrets the necessity of stating these theorems dogmatically.

senting these motions to a class of young students, especially when it is remembered that the first logically justifiable definition of length occurs in the Integral Calculus. What I have said here is then in full accord with the previous proposal to use the intuition freely in elementary instruction. The teacher, on the other hand, should not be ignorant of the fallacies involved in the ordinary argument: (a) that the straight line has no inherent property of being the *shortest* line, until we have defined what we shall mean by the word "length;" (b) that there are reasonable definitions of length, which lead to practical results of value, for which the straight line is *not* the shortest distance between two points; (c) that our notion of ordinary motion is susceptible, besides the extraordinary changes involved in the above geometries, of simple restrictions, such as the elimination of rotation, which lead to the most beautiful results; or of extension, as by the introduction of reflection, dilitation, and so forth, under the category of motions; (d) that the idea of motion may be derived logically from that of length; (e) that the axioms of congruence are at the basis of the ideas of length and motion; and (f) that a strictly logical definition of all three terms may be arrived at by means of the Integral Calculus, the length being defined by means of a definite integral. These are of course only a few of the many interesting and valuable facts. That geometries exist in which the shortest lines are straight lines, but which do not coincide with ordinary Euclidean geometry, has been known for many years, and the Cayley-Klein geometries offer the most beautiful examples of this type. What forms have been given to these developments in recent years, may be traced in the papers read before the American Mathematical Society which are reported in the Bulletin, in papers published in the periodicals already alluded to, and in papers to which references will be found in the latter.

In this connection the treatment of ratio and proportion usually given in secondary schools naturally comes into question. The teacher is recommended, if he reads German, to study the elegant and extremely simple presentation given by Mollerup, in an article in the *Mathematische Annalen* for 1902, which can be found in the University library.

Another very practical conception is that of number; and we find that many common assumptions are invalid. Is there a least number greater than zero? How shall we convince ourselves of its non-existence? Are there any two numbers, such that no multiple of the smaller exceeds the larger? Curiously enough, there might be, in the systems of axioms usually assumed for elementary arithmetic; and it is necessary to exclude this possibility by explicit statement, in the form of an axiom, if we wish to avoid such extraordinary and undesirable combinations: that this *is* advisable appears when we consider that motion, as ordinarily conceived, would be impossible in a geometry in which such quantities were allowed to occur. The avoidance of a bad use of the words "infinity", "infinitesimal", "infinitely small", and so on, becomes imperative, under the circumstances; and the teacher will surely lead the student to the most vicious misconception, unless he is very careful to make the whole matter clear in his own mind, and to choose his language at all times with the utmost care, when referring to these delicate subjects.

It should be borne in mind constantly that the above axiom, known as Archimedes' axiom, though too nice to be introduced into elementary instruction, is really at the basis of all arithmetic and geometry; and the astounding properties which an arithmetic, or a geometry, may have, if this axiom is expressly omitted or violated, should prove an effective warning against its neglect by teachers, in their expressions before students. It is not uncommon, for example, for teachers of geometry to refer to infinite quantities in such a way as to imply a direct violation of this axiom, and this before students whose minds are in the formative stage; while the references sometimes made to infinitesimal quantities by teachers and even by books on the Calculus, seem to denote an utter disregard of its fundamental character.

Is it possible to distinguish between the number of positive integers and the number of positive fractions? It is indeed singular that it is not. But we *can* distinguish between the number of positive integers and the number of positive numbers as a whole (including the incommensurable numbers). But, again, there is no means of distinguishing the number of points on a line (i. e., the whole number of numbers) from the number of points in a square, or from the whole number of points in a plane; for these two sets of points can be paired off, one to one, so that each point of the line is mated with one point of the plane, and conversely. These are, however, merely isolated questions, which are suggested only to inspire curiosity and inquiry, on the part of any to whom they may be unfamiliar. Nevertheless, precisely these questions, and other similar ones, are coming to play a rôle in modern mathematics which is fundamental, and almost preponderant.

I have tried to make clear my two first propositions: that it would be well for the teacher to familiarize himself with the resuhts of modern mathematical research as far as possible; and that in so doing, it is not that the direct instruction to the student would or should be altered in *form*, but that the teacher's own increased appreciation might reflect indirectly upon his teaching *truer conceptions of things as they are*. I have not touched upon such important subjects as limits, and infinite series, because a study of these subjects would be of less direct influence upon elementary teaching, the mastery of their fundamental principles would involve a more thorough training than I have wishd to assume, and ignorance of them would be less likely to lead to inefficient teaching in secondary schools. On the other hand, I have laid speciai stress on the matter of axioms, on account of its importance, and on account of its present accessibility in a form which the average teacher can master.

In addition to the suggestions already made, I would suggest to any teacher interested in improving his knowledge or his teaching, two methods of doing so, aside from the study of books. In the first place, there might well be, on any teacher's table, a copy of some reputable periodical magizine or journal devoted to Mathematics. This should be, however, a journai in good standing, and not one devoted to the solutions of trivial problems. At least one such is, fortunately, available: the *Annals of Mathematics*, published quarterly at Harvard University, by a board of editors from different universities. Some of the articles which appear are readable without any advanced

knowledge, and others will inspire the reader to further investigation and study. This is the only American mathematical magazine in which elementary work appears, which can be generally recommended; but *it* can be recommended to any serious teacher whose training includes at least two years of college work. For the other American journals to which I have referred, as well as for foreign books and periodicals, the average teacher might well rely upon the University library.

Another means which suggests itself at once, is close alliance to the University; and this will recommend itself to the members of the Schoolmasters' Club. Attendance at the meetings of the Club, and use of the library at such times, to clear up difficulties which may have arisen in the interim; attendance at the Summer School; or, better still, if possible, an occasional whole year spent at the University, will help the teacher surely and remarkably in his work.

I will try to be as brief as possible in the discussion of my remaining theses. They regard the student rather than the teacher.

It is not a new idea that mathematical instruction should be illustrated by practical problems, drawn from Physics and from other sciences. In fact, every branch of mathematics has had its *origin* in problems of an *extremely* practical nature. But the separation which was effected in the early part of the nineteenth century, between mathematics and its applications, has been carried to such an extreme that the studies of a purely mathemathical nature and those applications pertaining to Physics, have been wholly separated, not only in the secondary schools, but also in our colleges and universities. From the standpoint of the student this state of affairs is extremely deplorable. It leaves the study of mathematics *dry, unpractical,* and often *meaningless,* to him; and, whether he is to go on in mathematical studies, pure or applied, or whether he is to leave the subject permanently, it is of equal importance that he should be made to see the bearing of the subject, and its real significance in its applications. At just this time it is worth the effort to try to effect this change, the advisability of which is generally admitted, in a greater or lesser degree. For the leading minds in mathematics, physics, and engineering are just now giving their most thoughtful attention to a similar necessity in advanced work. Poincaré, himself a mining engineer by training, is now the acknowledged leader of pure mathematics in France; and his papers in the journal "L'Enseignement", and in the Transactions of the Paris Mathematical Congress,* demonstrate conclusively the practicability of this change, and its advisability from the standpoint of the future engineer, as well as from that of the future mathematician, or, indeed, from that of the student temporarily engaged in mathematical study.

The most extreme agitation at present is in Germany and in England. In Germany, proposal after proposal each meets its counter-proposal in

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*For precise references, here and later, see Moore, l. c., Bull., Vol. 9, No. 8, May, 1903, pp. 492, etc. See also Poincaré, La Science et L'hypothése, Paris, Gauthier Villars, 1903.

schemes for the revision of elementary and college instruction in mathematics—from engineers on one side, and from mathematicians on the other. The recent files of the "Bericht der Deutschen Mathematiker-Vereinigung", and the reports of the metings of the German Association of Engineers, teem with discussions which, although tinged with some local color, cannot fail to be illuminating and helpful.

What *can* be done is shown most plainly in the work and in the writing of John Perry, Professor of Mechanics and Mathematics at the Royal College of Science in London, and Chairman of the Board of Examiners of the Board of Education, in mathematical subjects. His work in his official capacities, and in connection with several committee reports on the improvement of mathematical teaching, as well as his actual experience in teaching mathematics of no mean order, to mechanics and apprentices in the London night schools, and still more his books and papers resulting from these experiences, are highly suggestive and supremely original.* Especially does his "Calculus for Engineers" show possibilities in such a subject for wide divergence from present methods of presentation, with reasonable hope for great improvement. While we cannot unhesitatingly approve all that Perry does or says, and while such changes as are to be made, must be carried out slowly in order to be permanent, yet his ideas may certainly be studied to advantage, and they are fortunately accessible in his papers, many of which are to be found in the library.

My latter theses are so ably maintained by Professor Moore in his Presidential Address, that I would best repeat his very words, were I to enter upon a detailed discussion of them. In fact, to sum up the results of his reasoning, we would be led to practically restate these propositions, with considerable amplification and appropriate explanation.

Let me attempt to sketch such a resumé. In the first place, that elementary mathematical instruction should find its logical explanation in examples drawn from practical physics and mechanics. There seems to be no doubt that this is actually feasible at present, if teachers and authors of text-books would unite to secure the desired end. That Physics and Mathematics should eventually be consolidated, is one of the propositions advanced by Professor Moore; and, while we cannot hope for this result immediately, it does seem possible and advisable that much of the matter and some of the examples now included in High-school and Freshman college Physics, should be incorporated in text-books and in courses in High-school mathematics. At least the student should be relieved of the idea that truth in one room, under one instructor, is essentially different from related truth taught across the hall, by another; *such* is, and has been, the extreme divorce of Mathematics from Physics in our High-schools, and of Mathematics from Physics and Engineering in our colleges and universities.

It has been suggested that such a reform would necessitate the omission of some of the material now given; and it is doubtless true that such a pro-

*Again I would refer the reader to the bibliography given by Professor Moore, in footnotes to his Address.

gramme as that proposed by Professor Moore, if carried out in full, would cause some abridgements. It would seem, however, that such sacrifices would be more than compensated for by the improvement in the students's general grasp of the subject, and that a net gain could be realized. It is very doubtful to my mind, for instance, whether the student gains much from the *logical* part of *solid* geometry. The logical forms have all occurred in the teaching of *plane* geometry, and hence the processes used in the logical deduction of theorems are practically, for educational purposes, a needless repetition. If *plane* geometry could be assigned more time, at the expense of *solid* geometry, so as to afford time for the introduction, into plane geometry, of a few physical problems, and of some of the laboratory work of which I shall speak, I believe the student would *learn more geometry* in the end. Of course I would not neglect that great merit of solid geometry—its development of the space intuition, and of the ability to project a plane diagram into a space figure, and conversely. But I believe that the teaching of solid geometry could be *stripped down to almost nothing else*, by assuming most of its theorems by an appeal to the intuition, which needs practice if not development, and by emphasizing what is *new* in solid geometry, *only*. The general notions of projection and the general space relations, can be taught without the accompaniment of the petty logical processes which usually crowd the first part of a solid geometry text. I would propose even more thorough drill in these things, with even additional matter, taken from the elements of descriptive geometry and of the theory of perspective, accompanied by the drawing of diagrams, and the construction of actual models. With this, much attention should be paid to such new and important general principles as that of Cavalieri; which, as far as I know, is to be found in only one American High-school text—that of Professors Beman and Smith.

The same general remarks apply to the teaching of Algebra. Doubtless some of the matter now taught could be sacrificed, if necessary. In particular, the treatments of series, permutations and combinations, simple and compound interest, and so on, might be omitted. If we could introduce, in their stead, algebraic problems drawn from actual problems of physics, mechanics, and geometry, a gain might be effected in the student's total algebraic power. And now that the cross-section paper of analytic geometry is in common use for diagrams in mechanical machines of all sorts, by railroad offices, by insurance men, by even the daily newspaper, it seems certain that a high school student could grasp the use of this convenient mode of expression, as applied to practical uses and to practical problems, if not as a graphical means of studying equations and their roots. Perry's essay on "Square Paper" would be helpful, in such a connection, in freeing analytic geometry from its incubus of artificial names, words, and signs.

What I have said naturally leads to the idea of a mathematical laboratory, for the suggestions already made would be quite sufficient for a beginning. What with the drawing of accurate figures, and diagrams of solids, supplemented by some practice in practical draughting; with the construction of actual models in paper, wood, tin, plaster, and other available material; with the metrical experiments of weighing and otherwise measuring solids

and planes; with the construction of graphical time-tables, physical laws, statistical curves, and other similar figures, on cross-section paper; all the time and means at present obtainable for the purpose, could be profitably spent. I believe that the outlook for a mathematical laboratory in the high school is at present actually brighter than was the outlook for a high school physical laboratory, twenty years ago, not to speak of chemical, biological, and other laboratories, which are in common, and highly successful, operation in our High-schools today. What the development of the High-school mathematical laboratory might be, and how beneficial in its effect on the student's grasp of the subject, may be guessed from the known results in other subjects, if it is not inherently apparent.

The same general ideas apply, with added force, in fact, to instruction in colleges. Illustrations and applications drawn from other sciences are, indeed, not wholly lacking, but they might be made vastly more effective and helpful, by increasing their number and their practicalness. Especially is this true of the Calculus, which so sadly often leaves the student with the notion that mathematics is a dreamer's raving. Might not more time be given to the applications of the Calculus to Mechanics, and less to the traditional "applications" to the theory of curves and surfaces? Is not the idea of a derivative more clearly illustrated by a *velocity* than by the slope of a curve?—at least it was in this way that Newton conceived of it, when he invented the Calculus. And can there be any comparison between *acceleration* and *curvature* as a simple illustration of a second derivative?

But it was not my purpose to touch upon the instruction of mathematics in colleges, so much as to urge reform in our secondary institutions. As for the laboratory idea, I will merely mention that modest laboratories have already been started at Yale and at Chicago, at least. Let us hope for their success and development, and for the gradual introduction of laboratories in all large colleges.

Finally, it is apparent that such changes cannot be made by teachers in secondary schools without the co-operation and assistance of the University. Texts must be written, the use of which is at least not fatal to such a course; but these will come in time; our recent text-books show enormous improvements in precisely these directions. Teachers must be trained to understand the meaning and the purpose of the proposed reform; but our present university instruction is sufficiently literal to give hope that a beginning might be made at once. The only serious difficulty in the way of an immediate beginning is the obvious necessity of a change in college entrance requirements.* It is clear that an alternate system of examinations would be needed, which would admit of either method of instruction. But this change *must be made at once*, if any considerable alteration in our High-school Curriculum is to be fostered. That such a change would be advisable is not the isolated

*In this connection mention should be made of the recent Provisional Report of the Committee of the American Mathematical Society on Definitions of College Entrance Requirements in Mathematics, which has been sent to the members of the Society.

opinion of the writer, but is maintained by all those who look for improvement in secondary instruction along the lines which I have suggested; and I trust that those in authority in all of our larger colleges, will see their way to a *gradual* change in this direction. It is particularly desirable in the State of Michigan, that the stimulus for improvement should come from the University, on account of the ascendancy of the University over the secondary schools of the state, and on account of the intimate relations existing between the University and the Schoolmasters' Club. Should the members of the Club coöperate with the University authorities to promote and encourage such reforms as those which I have indicated, I believe that a marked improvement would be felt immediately in the instruction in mathematics, throughout the secondary schools and the colleges of Michigan.

I would reiterate, however, that my statements are not intended to be a final *dictum* on the subject. But that some such reforms are inevitable, and that we must either bend or break, under the pressure of their necessity, seems certain. I shall feel highly gratified if my tentative remarks only lead to serious discussion, and to awakened interest on the part of the members of the Club.

MATHEMATICS IN THE SECONDARY SCHOOLS OF NEW YORK CITY.

CLIFFORD B. UPTON, HORACE MANN HIGH SCHOOL, NEW YORK CITY.

A visitor to the busy metropolis who expects to find a thoroughness and enthusiasm in the teaching in the secondary schools which corresponds to that in the commercial life of the city will not be disappointed. He will discover school work here which is in all respects equal if not superior to that of any other city in the Union, and will leave with the feeling that much of value has been gained from his observations.

Greater New York, which is a single municipality formed by the consolidation of New York, Brooklyn, Long Island City, and several adjoining towns, has in all twenty public high schools which have a combined attendance of eighteen thousand students, about two-thirds of the total number attending all the high schools in Michigan; five thousand more students are found in the private secondary schools, all of which do excellent work and which also must be visited if one would become thoroughly familiar with the teaching in the city. It is readily seen that it requires no small amount of time to visit but a single department of so large a number of schools, yet an examination of the typical schools will give one a just estimate of the entire system. Having spent one week visiting the mathematical departments of the most prominent public and private high schools in New York and Brooklyn the writer will attempt to give some idea of what is being done in them in the teaching of secondary mathematics.

Year of Course	NEW YORK CITY: Horace Mann High School (Private)	New York High Schools (Public)	New York Commercial High School (Public)	Dr. Sach's Collegiate Institute (Private)	Chicago High Schools (Public)
1st sem. I	alg. 5	alg. 5	alg. 4	alg. 2	alg. 4
2nd sem.	alg. 5	alg. 5	alg. 4	alg. 2	alg. 4
1st sem. II	pl. geom. 5	pl. geom. 4	pl. geom. 3	pl. geom. 2 alg. 3	pl. geom. 4
2nd sem.	pl. geom. 5	pl. geom. 4	pl. geom. 3	pl. geom. 2 alg. 3	pl. geom. 4
III	2 1 *alg.-geom.* 3	pl. geom. 3	pl. geom. 3	pl. geom. 3 alg. 3	*alg.* 4
	2 1 *alg.-geom.* 3	alg. 3	alg. 3	pl. geom. 3 alg. 3	*sol. geom.* 4
IV	*trig.* 3	*sol. geom.* 4	*sol. geom.* 4	pl. geom. 3 alg. 3	
	sol. geom. } *alg.* } 3	*alg.* or } *trig.* } 4	*trig.* 4	pl. geom. 3 alg. 3	*trig.* 4
	32	32	28	38	28

The numbers after each subject indicate the number of recitation periods a week.

The length of the recitation period in each of the above New York courses is 40 minutes.

The numbers under each course indicate the number of recitation periods per week for one semester which would be equivalent to the total time spent reciting mathematics during the four years.

Subjects in italic are elective.

The course of the Chicago High Schools is added for comparison.

The course of study in mathematics first attracts our attention. It is the same for all the twenty public high schools of greater New York, except the manual-training and commercial high schools, and even in these the variation from the regular course is very slight. Furthermore, equal amounts of algebra and geometry are covered in the various schools during each semester, the exact requirements being given in a syllabus recently prepared by the superintendents, after consultation with the heads of the mathematical departments. Referring to the tabulated course of study it will be noticed that plane geometry occupies all of the second year and the first semester of the third, while solid geometry is given the first semester of the fourth. The syllabus just mentioned requires in the second year the first four books of plane geometry plus a minimum of three hundred exercises, and in the first half of the third year the completion of the subject plus a minimum of seventy-five exercises. In algebra simultaneous quadratics must be finished in the first year, while in the third year the first year's work is reviewed, and ratio, proportion, series, and the binomial theorem are added. In the mathematics of the fourth year the student is prepared for his college entrance examinations and is given practically what he needs for the particular college he wishes to enter; he may have solid geometry and plane

trigonometry or even advanced algebra, if he happens to be preparing for some technical school. The public high schools can easily satisfy the various demands in the senior year, as each large high school has from ten to fifteen teachers of mathematics, with each course divided into several sections.

The course of the Horace Mann School is a typical private school course. Plane geometry is finished in the second year, and is reviewed one hour a week during the third year, in connection with a two-hour course in algebra; the fourth year is similar to that of the public high schools. The other courses explain themselves. Dr. Sach's school is especially strong in mathematics, and the course is of interest in showing what division is made to carry algebra and geometry side by side during the last three years. A general examination of all the New York courses will now show the following important facts:

(1) There is an almost absolute uniformity in all the courses of both public and private schools.

(2) The work is extended over the entire four years, so that no semester is without its mathematics. The work is thus constantly kept fresh in the student's mind, and this without any disturbance in the sequence of the course.

(3) A requirement of three years work in mathematics from all students in the public high schools.

PUBLIC HIGH SCHOOLS OF MICHIGAN

Year of Course	Detroit	Jackson	West Saginaw	Ann Arbor	Kalamazoo	East Saginaw*
I	alg. 5 alg. 5	alg. 5 alg. 5	alg. 5 alg. 5	alg. 5	alg. 4 alg. 5	*alg.* 4 *alg.* 4
II	 alg. 5		 alg. 5	alg. 5 alg. 5	alg. 5	2 3 *alg-geom.* 5 2 3 *alg-geom.* 5
III	pl. geom. 5 pl. geom. 5	pl. geom. 5 pl. geom. 5	alg. 2½ pl. geom. 5 pl. geom. 5		geom. 5 pl. & sol. geom. 5	*geom.* 2 *geom.* 2
IV	*sol. geom.* 2½ *trig.* 4 *alg.* 2½	*sol. geom.* 5 *trig.* 5 *alg.* 5	sol. geom. 2½	geom. 5 pl. & sol. geom. 5 *trig.* 5	*trig.* 4	*alg-geom.* 3 *trig.* 2 *alg-geom* 3 *trig.* 2
	34	35	30	30	28	32

*East Saginaw has required work in algebra in the seventh and eighth grades.

Subjects in italic are elective.

For the sake of comparison several of the typical Michigan courses have been added. No longer can it be said that the chief difference between the courses of study in the East and the West is that the East devotes one year

to plane geometry while the West devotes one year to both plane and solid; the East has added solid geometry, although as an elective, and the West is giving more time to plane. Detroit, Jackson, and West Saginaw each devote the entire third year to plane geometry, putting solid geometry in the fourth, while Kalamazoo and Ann Arbor still cover both plane and solid geometry in a single year. This leads us to make a general examination of the Michigan courses with these results:

(1) There is no general uniformity in the courses, although Detroit, Jackson, and West Saginaw are quite alike.

(2) There is no school which spreads the work over the entire four years, except East Saginaw. In that city this result is attained by dividing the subjects to such an extent that a student changing from one school to another before graduation would be placed at a considerable disadvantage.

The numbers under each course of study indicate the number of recitation periods per week for one semester, which would be equivalent to the total amount of time spent reciting mathematics during the four years. It is thus seen that some of the Michigan schools spend more time upon mathematics than either the New York public schools or the Horace Mann School, and still do not secure the New York advantages of continued sequence and uniformity. The course of the Commercial High School of New York is an excellent example of what may be done in the distribution of the work over the course, using no more time than the minimum of any Michigan school.

The extension of the work through each semester of the course is secured by placing plane geometry in the second year. This plan is so simple as to raise the question as to whether there is any reason for not placing it there. By starting slowly, and devoting a year or even more to plane geometry, a student can take it up in the second year with an interest very much greater than that with which he would study algebra in that year, and in addition the plan gives him a good general mathematical training before commencing the study of physics. This would leave the third and fourth years for an arrangement similar to that in the New York courses.

With much interest the writer has watched the courses in Michigan for several years and it certainly seems that they are in a stage of transition. From a single year's work in plane and solid geometry in the fourth year they are changing to a whole year of plane gometry in the third year and a semester of solid geometry in the fourth, with a general tendency to extend the work over each semester of the entire four years. Uniformity and division seem to be the goal, and the writer firmly believes that a few more years will find all of the Michigan courses uniform with those of New York and Chicago.

The teachers of the secondary schools in New York are an interesting body; their scholarship is high, their experience large, and their personalities are especially attractive. There are three grades of teachers in the public high schools, and before election a teacher must possess the qualifications of the grade for which he applies in addition to passing a very rigid

examination in mathematics, the methods of teaching it, and the science of education. The requirements of the different grades are as follows:

The head of the department, called first asistant, must be a graduate of a recognized college or university, and must have had at least one year's satisfactory post-graduate work, besides five to seven years of successful experience in teaching in secondary schools or colleges. His salary for the first year is $2,500 with an annual increase of $100 until a maximum of $3,000 is received.

The second assistant must be a college graduate and have had at least two years of successful experience in teaching in secondary schools or colleges. The first year's salary is $1,300 with an annual increase of $110 until a maximum of $2,400 is received.

A teacher of the junior grade must have a college degree and have completed a satisfactory pedagogical course of at least a year, all in addition, of course, to the above mentioned examinations. The salary starts at $900 with an annual increase of $50 until a maximum of $1,200 is reached. All the salaries quoted are those of men, the women receiving salaries correspondingly high, though a little less in amount.

What is the result of these requirements and these salaries? There can be but one result and we find that here. The teachers are thoroughly prepared for their work, and, in addition, are broad-minded, liberally cultivated men and women. They are teachers in every sense of the word. In the private schools the faculties are equally competent, and men with master's and doctor's degrees are found in almost every such institution.

It is of interest to note in this connection that New York City now has the best facilities of any city in the country for the thorough preparation of teachers of mathematics; more extensive courses in the pedagogy and history of mathematics are offered than in any other city, while certain collections of original sources here, which bear directly upon the teaching and history of mathematics, are now the largest and most complete in the world.

As to the spirit of the work and methods of teaching much can be said. It is just the spirit that one would expect from teachers with the education, training, and personality required by the New York Board of Education.

First of all, thorough, rigid mathematics is taught. Every detail is thoroughly emphasized and the student is expected to master it. There is an excellent appreciation of a student's needs, while mistakes and difficulties are skillfully cleared away. There is a constant requirement of clear thinking, with exact and concise statement, while carelessness is not tolerated for an instant. But this emphasis of the long recognized disciplinary features of mathematics is not all that is found; the distinctively newer life and scientific spirit which have now come into the teaching of secondary mathematics are discovered to quite an extent, and give evidence of spreading very widely throughout the city within a short time.

In algebra the syllabus in mathematics just prepared for the public high schools, advises the teaching of detached coefficients, the remainder theorem, the treatment of quadratic equations immediately after factoring, and the checking by short methods of not only all the fundamental opera-

tions and factoring, but also of the roots of all equations. Many of the teachers have been doing these things for some time and have also used graphs very freely in the study of equations.

In geometry it is gratifying to see the interest taken in exercises, the syllabus requiring that at least 75 be taken up with each book of geometry, and some of the contributors to the syllabus even favored requirements and suggestions as to methods of attack for these exercises, although this feature has not as yet been inserted. However, the fact exists that many of the teachers have already made a good beginning in presenting general methods of attack, and an extension and requirement of this practice is soon looked for.

The writer found several teachers who also introduced choice bits of the history of mathematics to make the work more real and interesting.

So anxious are a few of the teachers to improve their work, that they are trying the no-text plan in geometry and the individual or laboratory method for algebra, and, it is claimed, with excellent results. The great majority, however, are following the plan which long experience has proved the best, i. e., of following a good text and carrying on a live recitation.

Another commendable thing is that there is no uniform text which every school must use; the Board of Education furnishes a list of 42 of the best American algebras and 40 geometries, from which each high school may select the texts it wishes. It is also of interest to add that several of the most prominent private schools have lately discarded the older texts for the more rigid and modern books.

The above are not theoretical statements but are the results of the writer's personal investigations in the schools themselves.

So far the general spirit of the work in the public high schools has been discussed. A few words may now be in place concerning the work in the largest and most prominent private school in the city, the Horace Mann School. This is the school of observation of Teachers College of Columbia University; it is supported and controlled by Teachers College and is a part of the Columbia University system. It has an attendance of a thousand students, about one-half of whom are in the High School. It is a private day-school, and a high tuition is charged, but it is not a school for general practice teaching, Teachers College maintaining a free school in another part of the city for that purpose.

The mathematical department of the high school is supervised by Dr. David Eugene Smith, professor of mathematics in Teachers College, and it is in this high school department that the spirit and methods of the pedagogical courses given by him in Teachers College are carried out. The spirit of the teaching is entirely modern, and all of the real improvements in the teaching of mathematics are here put into practice. It is not a department of fads but a place where methods of teaching are used which the history and pedagogy of mathematics have proved to be thoroughly sound.

All of the rigorous teaching noted in the public high schools is here found, and in addition all of the usable modern notions are taught with great success.

In algebra the students are given almost their first ideas of formal mathematical reasoning, and find that the subject is made up of definite principles. They better appreciate the meaning of the new kinds of number in algebra because they have been given parts of the history of our interesting number system. When an expression to be factored does not fall under one of the ordinary types, they quickly and intelligently apply the remainder theorem and they know their results are correct because their work checks, an answer book being an unheard of thing; while the usual maze of quadratic equations is clearly seen to be nothing but factoring. It does not require an extra amount of time for this modern work, but on the other hand, it is found that the interest in it rather facilitates than retards the speed over the required ground. This work is all done in a thirty-three weeks' school year by students of only average ability who all carry heavier programs than the average public high school student.

In geometry a like interest is found, and this too in the second year of the high school course where experience has shown that geometry can readily be taken up. Principles of wide application are readily grasped, such as those of continuity and the law of converse, and the students delight in generalizing a figure or in proving a converse theorem by means of the law. General methods of attack are early given to the student, and the exercise work is full of enthusiasm as a result. The history of geometry is frequently found to be a means of adding intense interest to the work, the boy knows why in elementary geometry he uses only the straight edge and compasses, and why it is useless for him to attempt to trisect an angle. Here, too, it is found that the work is made lighter rather than heavier by an appeal to the modern methods.

Another source of inspiration to the students is the high school mathematical library. Here are found books on mathematical recreations, the best histories of mathematics in English, the classic texts in algebra and geometry, besides many little books, like "Flatland," which make one feel that mathematics is not only a very interesting but a really fascinating subject.

The department of mathematics also possesses a complete set of the latest German models for illustrating the theorems in solid geometry. These are, however, used with considerable discretion, and are not allowed to rob the subject of its value as an exercise for the imagination.

The teachers are enthusiastic and get their enthusiasm from the head of the department and from their acquaintance with the very best literature upon the subject. All the leading foreign and American texts are available and are consulted. The work is thoroughly systematized and there is a general uniformity in method and spirit throughout the department.

In conclusion it can be said that the teaching of secondary mathematics is exceptionally good in New York City and this excellence is not accidental, but the result of natural causes. A good course of study, and salaries sufficiently high to obtain thoroughly prepared teachers must produce good results. And further, with the awakening to the fact that not only a thorough academic training, but also a strong course in the pedagogy of mathematics is the necessary training for a teacher of high school mathematics we shall find our teaching taking on a new life.

TO WHAT EXTENT SHOULD ARITHMETIC, ALGEBRA, AND GEOMETRY BE TAUGHT TOGETHER?

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A text for this paper may be found in one of the recommendations of the mathematical conference of the Committee of Ten, viz., "The course in arithmetic should be at the same time abridged and enriched." Deferring the question of abridgement, the more immediate topic will be the enrichment of the course in accordance with the demands of the subject-matter of the great science of mathematics and of the nature and development of the child.

It would be interesting to trace the origin of the present arrangement of the mathematical studies of our primary and secondary schools,—first for eight years repulsively and fatally large portions of arithmetic in the American acceptation of the word, then for a certain period algebra as a study entirely distinct from the preceding, then demonstrational geometry quite as distinct, each isolated from and neither helping nor helped by the others. Was it due to the limited attainments of the instructors in those branches? Or was it in obedience to the commercial spirit of the communities that the mathematical portion of the course pursued by the majority of children should be devoted to those topics popularly supposed to be helpful in business transactions, but now admitted to be of very slight value either commercially or mathematically? They not only fail to bring about that quickness and accuracy in computation essential to success in either business or student life, but effectually kill off any fondness for mathematical study or powers of clear and exact reasoning.

It is obvious that the foregoing classification is highly artificial. The algebra of our secondary schools is esentially the same as the arithmetic which goes before, differing only in the generality due to the employment of the literal notation and the introduction early in the process of solution a symbol representing the unknown desired number. A more scientific classification would seem to be the following: Arithmetic, Geometry, and beyond these Analysis. Arithmetic is the science—and, like all the others, the art as well—of constant numbers, discrete at first, later also continuous number. It includes the elementary arithmetic of the first four fundamental operations, the literal or general arithmetic commonly called elementary algebra, and higher than these the theory of numbers and the theory of number systems. Geometry concerns itself with form and space relations and includes observational, constructive, demonstrational Euclidean and non-Euclidean, projective, vector, and analytic or coördinate geometry. The term Analysis is used to include all that nongeometric mathematics which results from the introduction of continuous variable number, beginning with the calculus, the threshold to all higher mathematics.

In no branch of higher mathematics do we find ourselves concerned exclusively with one of the two latter classes, but continually use processes and illustrations taken from both with the utmost freedom. The form side and the number side are but the two aspects of the one science of mathematics. This mutual dependence and helpfulness are equally characteristic of the elementary branches. Arithmetic in its beginnings has to do not with abstract but with concrete numbers. It grows by means of and concerns itself very naturally with geometric relations and measurements. On the other hand geometry at once depends on and enriches the arithmetical and algebraical processes and results, while elementary algebra is, as I have said, a generalization of the other two and affords an invaluable mechanism to aid in their investigation.

Not only is all this true from the standpoint of the nature of the subjects themselves. It accords equally with the needs of the developing mind. If we assign to either arithmetic or geometry the earlier place in the growing child's mind, it must be to the latter. Forms of objects constitute one of the first and most fruitful and abiding concerns of the child's mental activities. He learns to count as he learns to distinguish between different objects, and the relations between the parts of objects afford an easier and more interesting occupation than the relations and combinations of abstract numbers. Even when the child has advanced from the observational to the reasoning stage, how many high school seniors can either comprehend or give the demonstration of a theorem in algebra as understandingly and successfully as that of one in geometry?

In view of this intimate interrelation between arithmetic and geometry, and because they form but two aspects of the science and art of mathematics, it follows that they should be developed side by side in a course of instruction pretending to educate the whole child. This should, of course, be done with due regard to the peculiar rights and values of each. For example, danger lurks in the too complete substitution of the numerical method of demonstration for that which is purely geometric: The Pythogorean proposition, for instance, may be demonstrated by a purely geometric method or by a substitution of the symbols representing the number of units of length in the sides and the employment of the algebraic theorem of the square of a binominal. In the report of the Committee of Fifteen, in an argument against the early study of geometry, the one method is mistaken for the other.

Concrete or observational geometry ought then to be given a place early in the curriculum and throughout. The chief ends to be secured by early geometrical teaching are accuracy of observation and definiteness of imagination. These uses of geometry have been strangely neglected by both friends and foes of this intellectual training, who have considered only the continuity of thought and the consecutive dependent argument. But the powers of perception and of imagination, or conception, are of quite as great importance as those of reasoning. They give us the basis of facts without which reasoning is vague and worthless. The early study of the child, therefore,

while seeking to develop his ideas of space and time, must do so by training him to rapid and exact observation, clear and definite conception.

This observational or inductive side of mathematics may well be emphasized. It is common for non-mathematical writers to consider all mathematics as of the same nature as Euclid's Elements, starting from certain assumed definitions and axioms and proceeding by connected deductive reasoning to a final conclusion. Says Professor Huxley: "Mathematical training is almost purely deductive. The mathematician starts with a few simple propositions, the proof of which is so obvious that they are called self-evident, (sic!) and the rest of his work consists of subtle deductions from them." And again: "Mathematics is that study which knows nothing of observation, nothing of experiment, nothing of induction, nothing of causation."

Lagrange, than whom no higher authority could be quoted, has expressed emphatically his belief in the importance to the mathematician of the faculty of observation. Gauss has called mathematics a science of the eye. Riemann has written a thesis to show that the basis of our conception of space is purely empirical and our knowledge of its laws the result of observation. Sylvester, in an address before the British Association, cites many notable examples of analysis discovered by observation and established by induction and verification, the deductive proof following long years afterwards.

From this argument we must not conclude that the mathematical laws should be allowed to remain standing on an empirical basis, nor infer that mathematics affords the best training in observation and experiment. The biological and physical sciences are undoubtedly much better adapted to the latter purpose, while the inductive stage of mathematical study must gradually pass over into a demonstrational one, increasing in rigor as the mind gains in power of connected, exact reasoning. The present contention is that this gradual development should continually extend over both the arithmetical and geometrical sides of the science, so that both may keep pace with the other mental activities of the child to afford an even well rounded development. Such a course does not consist in an attempt to memorize or discover independently demonstrations for the theorems of Euclidean geometry, nor is it satisfied by including in our arithmetics numerical exercises in mensuration. The first would be time and endeavor worse than wasted in the lower grades. The latter affords a valuable enrichment of arithmetic, but little more. The study of the properties and relations of geometric forms by means of close observation, oral and written descriptions, and constructions will afford abundant material for the pursuit of geometry for itself. Time for it can well be spared from that now devoted to arithmetic, without sacrificing the true interests of that subject.

As to elementary algebra, i. e., literal arithmetic and the use of the equation and the symbol for the unknown quantity, abundant appropriate and valuable opportunity is afforded for its introduction whenever the pupil evinces sufficient ability to generalize. Thus the laws of addition, subtraction, multiplication and division and the exceedingly simple relations of

percentage all find convenient expression as formulas or equations. Here great care must be exercised that not the empty symbol but the content should ever be present in the pupil's mind. Frequent exercises in interpreting the formulas and giving complete verbal statements for them will tend to counteract this. Again the pupil must always realize that an equation is merely the symbolic writing of a sentence, a proposition in the logical syllogism of the argument.

The two likely errors in the introduction of geometry and algebra into the grades are, of course, on the one hand, a namby-pamby wasting of time, and on the other hand, an attempt to force the too immature minds to mental processes that are beyond them. To carry out this double program should not require more time than is now given to arithmetic in the primary schools. That the present results are lamentably incommensurate with the exertion is commonly admitted, and time is far too precious to waste. Deliberateness, however, not feverish haste and overcrowding, will accomplish most in the least time.

It has been the fortune of the writer to observe the results of two applications of curricula similar to that just described, both of which had passed beyond the stage of experiment into that of established success. In the German Gymnasium arithmetic (both decimal and literal) is taught simultaneously with geometry throughout the grades corresponding to those of our grammar and high schools, and about one year is gained over the best schools of our central states. For a very interesting and discriminating account of the Prussian schools with special reference to the work in mathematics, the reader is referred to Professor Young's little book.

Again in La Porte, Ind., under the superintendency of Dr. W. N. Hailmann, geometry and arithmetic were to be found throughout the first eight grades, geometry and algebra throughout the remaining four. The pupils came to the ninth (or first high school) grade thoroughly familiar with those properties of geometric forms open to observation and excellently prepared to take up demonstrational work, which was the more easily comprehended that it dealt with familiar material.

The abridgement by one year of the school course from the beginning up to the attainment of the baccalaureate is in the air. Can it be effected without sacrificing any valuable results now accomplished, say by wise revision of the curriculum and increased efficiency of methods of instruction? This is a question which, in view of the prominence of mathematics in the course of study, must vitally concern the teachers of mathematics. May not its answer involve some consideration of the changes suggested in this paper?

PHYSICS SECTION

THE USE OF MODELS IN SECONDARY INSTRUCTION IN PHYSICS.

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This topic is not quite in line with the usual,—and I think we would all say,—the best work of this section of the Club. It is offered as a suggestion of an occasional day upon some limited portion of our work, either of material or instruction. I have at present in mind two subjects to which my attention has been strongly called of late:—the relation of the mathematical to the physical instruction in the high school, and an exhibition of models which have been found useful in teaching physics

The subject of models is a large subject and shares in the fundamental difficulties of definition and classification common to all forms of apparatus. For this reason I shall entirely omit definition and attempt only a rough classification of models used in instruction.

CLASSES EXCLUDED FROM CONSIDERATION.

In the natural history sciences a model may mean a representation, often on an enlarged scale, of the whole or some part of some plant or animal. Large cabinets of such models in glass, wax, or other material, may be had. These are not for us.

Collections of models of machinery used in some technological process are often seen:—as, models of a spinning jenny, of a sugar mill, of an ore crusher, etc. Moderately useful as loan collections they are in general hardly worthy of purchase.

The term model is often applied to a simplified form of some complicated research apparatus; as, "Maxwell's Color-Box, Small Model", etc. May be important or not.

MODELS OF INFERIOR UTILITY.

A so-called diagrammatic model is likely to be inferior, other things being equal, to a working model. Such a model attempts to show by parts moving in one plane the action of a mechanism of three diamensions; or, if in three dimensions, it is not "practical", as the theatrical people say; or, it may represent to the eye and touch concealed or invisible parts. A representation in one plane of a section of a lifting pump, of a steam boiler,

of a Bramah press; or, in three planes, of a ray of common light, or, of the parts of an induction coil, are examples of this class. Reusch's apparatus for refraction; Pfaundler's of the course of a ray of light through compensating prisms; or Neu's for the course of a ray through a lens, in all of which the so-called rays of light are represented by wooden rods, furnish examples of this class of models. While these diagrammatic models are in general inferior in value, some of them are of high value, as, for instance, a representation in one plane of a steam cylinder with valve action and related parts. So this classification is not of itself sufficient.

A model of a complicated piece on so small a scale as to be a mere toy can have little value in class instruction.

Models showing mere theory one can in general well do without. The inventor finds enormous interest in making them, but his single example may well suffice. Models showing the nature of inertia, the interaction betwen the molecules of common matter and electricity, the nature of geyser action, of Saturn's rings, furnish examples of this class.

Models illustrating some fact or principle which needs no illustration are quite too common. For example, the rather common orrery or planetarium. I quite agree with Poggendorff that this piece is not only useless but actually harmful. The solar system certainly challenges imitation as well as admiration, and I do not wonder that attempts to represent these complicated motions and relations are often made, but why anybody should buy them is the mystery.

The paper was illustrated by models of a marine engine, of a vernier reading to hundredths, a vernier reading to thousandths, and one showing the locus of a connecting rod.

THE ELECTRON THEORY.

PROFESSOR K. E. GUTHE, UNIVERSITY OF MICHIGAN.

The electron theory which has lately attracted so much attention among scientists may be called the third stage of the development of our theories concerning phenomena connected with electro-magnetic action.

At the beginning of the second half of the nineteenth century *Wilhelm Weber* explained the electromagnetic phenomena known at that time, perfectly satisfactorily, by assuming the existence of two different kinds of electrical fluids, *i. e.*, positive and negative electricity. Electricity could be divided into small particles, atoms of electricity Weber calls them, which act upon one another through space, these actions being transmitted with infinite velocity. The idea of the electrical atom, however, did not at that time lead to attempts to measure its size. Many of our definitions and modes of speaking of electrical phenomena date back to Weber's theory.

It was *Faraday's* master mind which pointed out the short-comings of this theory and emphasized the great role which the medium plays in all electrical phenomena. Then *Maxwell* in his great treatise gave the mathematical basis for the electromagnetic theory of light, and *Hertz* by his famous researches proved that electromagnetic action is not an action at a distance but transmitted by the ether. The possibility of treating the phenomena of light and those of electromagnetic waves from the same point of view, led physicists to abandon Weber's theory and look to the ether and the lines of force, *i. e.*, the stresses produced in the ether, for the solution of all future problems in electromagnetism. According to Maxwell's theory there are no atoms of electricity. We have a continuous ether with certain electrical and magnetic properties and these properties may be modified by the presence of matter.

Now the third period in the development of the electrical theory which may be characterized by the name of the electron theory, means a return, at least to a certain extent, to the ideas of the first, or better, a combination of the two, *i. e.*, we have to allow a right of existence as well to the atoms of electricity as to the continuous ether with its electrical and magnetic stress properties.

In fact the "electric charge" has always been a more or less definite something, which has never allowed itself to be pushed aside entirely in an important branch of electricity, namely, in electrolysis. All attempts to explain electrolytic action on the basis of ether stress have found hardly any adherents among the physicists and we are accustomed to say that in electrolytes certain small particles of matter are charged with a definite amount of either positive or negative electricity, a combination which we call an "ion." When a current goes through a cell, the electric charge is given off at the electrode. It is apparent that, at least during the short time of transference, we think of the charge as having a separate existence. The smallest quantity of electricity found in electrolysis is then that amount which is carried by a monovalent ion—How large is it? We know that one gramequivalent of an ion, say 1 gram of H, carries very nearly 96600 coulombs. The ratio of the charge in electromagnetic units to the mass of one ion of hydrogen is ten apparently 9660 or nearly 1×10^4. The number of gas molecules in 1 cm^3 at 0^0 and 760 mm/cm^2 pressure of mercury is about 4×10^{19}. As an example take hydrogen. Each molecule is made up of 2 atoms; we nave therefore in each cubic centimeter about 8×10^{19} atoms. One grammolecule occupies 22350 cm^3 *i. e.*, there are 178800×10^{19} atoms in 2 grs. of H. These carry 2×96600 coulombs, so each ion has a charge

of $\dfrac{193200}{178800 \times 10^{19}} = 1.1 \times 10^{-19}$ coul. $= 1.1 \times 10^{-20}$ electromagnetic units.

Since an electromagnetic unit of quantity of electricity is 3×10^{10} larger than the corresponding electrostatic unit, *we obtain from the consideration of electrolytic phenomena for the electrostatic charge of a monavalent ion about* as 3.3×10^{-10} units.

Even in the electromagnetic theory of light where the wonderful success of Maxwell's theory seemed at first to leave no room for separate electrical charges, they began slowly to gain more and more ground. It was soon found that certain phenomena of light, e. g., radiation from incandescent vapors or the absorption of light by certain substances and especially the dispersion of light, demanded a definite structure of bodies. *Maxwell, von Helmholtz* and others assumed that the material particles emitting light of definite wave length possess one or more distinct periods of vibration and will on the other hand act like resonators for these vibration frequencies and therefore absorb their energy. Thus the material particles whose atoms carry positive and negative charges, were supposed to create by their vibrations electromagnetic disturbances of the ether.

H. A. Lorentz of the University of Leyden assumed as early as 1880 that not the material atoms of the substance but only an electric charge connected with it and having a vibration period of its own produces the electromagnetic phenomena of light. Starting from this hypothesis he was able to explain by means of a formidable structure of mathematical formulæ the apparent exceptions to Maxwell's theory. But Lorentz's greatest success was to come 16 years later; his theory, similarly to Maxwell's, had to wait for an experimental proof.

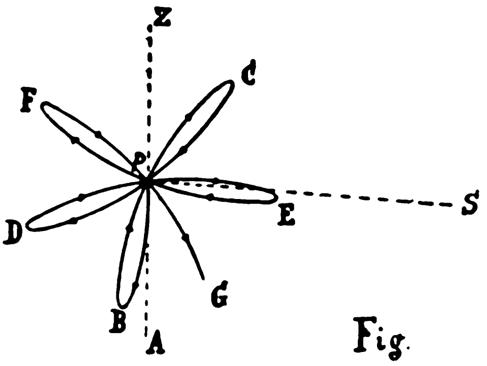


Fig.

Let us see whether his theory could predict effects of magnetic and electrostatic fields on light rays, which had not been observed before and which by being found would of course strengthen it. We suppose with Lorentz that the small electrical charges which we shall from now on call "electrons," a name first used by *Stoney*, swing rapidly about a point of rest and by their influence upon the ether produce light radiation. Let such an electron, which we consider as a negative charge, after it has left its position of rest be subjected to an elastic force pulling it back. It will swing then in a simple harmonic motion in a straight line and produce light of a definite wave length. But now suppose we bring this swinging electron into a strong magnetic field. A moving electrical charge will be acted upon as a flexible current would, *i. e.*, if we suppose the magnetic lines of force go from the front vertically through the plane of the paper and a negative electrical charge to start from the point, *P* (see figure —), vertically down parallel to

the plane of the paper, it would, instead of going to A, be deflected to the left so as to describe the path PB. After having reached its maximum elongation at B, it will return to its position but on a path concave towards the right and thus describe a loop. Constructing the path it takes during several vibrations, it will reach the points C, D, E, etc., the width of the loop depending on the strength of the magnetic field. We are accustomed to consider a motion in a loop as this as the resultant of two separate motions, say one in a vertical direction alone $A\ Z$ and one at right angles to it, along $P\ S$.

The question arises: What kind of light will be emitted from an electron moving in the manner described? Let us take the direction PS as the direction of propagation of the light. Light vibrations are always at right angles to its direction of propagation, *i. e.*, we must suppose that only the component at right angles to PS can be propagated in this direction as light, but not the component parallel to it.

It is apparent that the vibrations parallel to $A\ Z$ will alternately increase and decrease in amplitude. In sound we are perfectly familiar with such phenomena: we say we have "beats," whose effect is the same as if two vibrations with somewhat different periods were present. Our eye is not sensitive enough to see these extremely rapid light beats, but in using a spectroscope we should expect two lines of distinct wave length corresponding to these beats. Moreover according to the theory of light ether vibrations at right angles to the plane of the paper would also be propogated as light rays in the direction PS, but on these the magnetic field has no influence, *i. e.*, their amplitude remains constant. We shall therefore see in the spectroscope also a line between the other two, this line corresponding to the natural wave length of the light emitted by the body. The effect of bringing a body emitting under ordinary circumstances light of a certain wave length into a strong magnetic field and looking at it through a spectroscope in a direction at right angles to the magnetic lines of force, is therefore, that we see instead of the usual one bright line now a triplet of bright lines. This phenomena which Lorentz's theory demanded, has been found experimentally by *Zeeman* in 1896, it is the famous "Zeeman effect." Various bright lines emitted by incandescent vapours have been studied under these conditions and Zeeman has calculated from the mathematical theory the ratio e/m of the electrical charge to the mass of such a vibrating electron. For each of the two D lines he found it to be 1.6×10^7 electromagnetic units per gram, for the Cadmium line 2.4×10^7. Comparing this result with what we found above for the same ratio in electroytic phenomena, namely about 1×10^4, *we obtain the very surprising result that it is in this case more than a thousand times larger.*

Thus Zeeman by his famous discovery strengthened considerably the electron theory introduced by Lorentz into the electromagnetic theory of light.

While the new electron theory was originated in connection with Maxwell's theory, its importance was seen more clearly when purely electrical phenomena also demanded the existence of electrons. I refer to the interesting results obtained by the study of the "cathode rays." These rays are emitted from the negative electrode of a Crooke's tube, when worked with an induction coil; they travel in straight lines, can be deflected by a strong

magnet and produce at an object which they meet in their path the same effect which small particles of matter would if moving with great velocity. *Crooke's* hypothesis that these rays were charged gas molecules repelled from the electrode, had to be given up as soon as quantitative measurements of the ratio between the electrical quantity transferred and the corresponding amount of matter were made. Closely connected with these measurements are the names of *Wiechert, J. J. Thomson, Kaufmann, Lenard* and others. Their investigations have led to the result that *in cathode rays this ratio e/m equals about 1.85×10^7, i. e., the same number as the one found for electrons emitting light.*

Several different methods may be employed to calculate the ratio, the simplest one being the following:

If we have a strong magnetic field of strength H at right angles to the direction of the moving electrons, the force with which the charge is deflected from its rectilinear path equals $H\,e\,v$, where e is the charge on one electron and v its velocity. Acting against this force we have the centrifugal force $= mv^2/\,r$ and a steady deflection is obtained when the two are equal to each other, *i. e.*, $H\,e\,v = mv^2/r$, $r = mv/eH$ where m is the mass of the particle. The electron describes therefore the arc of a circle whose radius is $r = mv/eH$. Now H and r may be measured and thus mv/e found. To eliminate v let an electrostatic and a magnetic field at right angles to each other act at the same time upon the moving electron and adjust the strength of these fields so as to have one just balance the effect of the other. The force on an electric charge e in an electrostatic field of strength F is Fe, therefore under the given conditions $Fe = evH$ or $v = F/H$. Substituting this value of v in the above equation we obtain $v = m/e\; F/H^2$, or $e/m \;=\; F/v\; H^2$. Now we have on the right hand side only quantities which we can measure. By this or similar methods a great many observers have found the velocity of the cathode rays to be from 0.3 to 0.9×10^{10} cm/sec or about 1/10 to ⅓ that of light, while e/m by the most accurate methods was found to be about 1.85×10^7 electromagnetic units. The most important result however is that *for different gases this ratio does not change, i. e.*, "the electrons seem to form an invariable constituent of the atoms or molecules of all gases and presumably of all liquids and solids" (J. J. Thomson). To carry a given charge of electricity through an electrolyte requires therefore a mass at least 1000 times greater than if the carriers are cathode rays.

The question whether there are positive electrons has also been investigated. If in a Crooke's tube the negative electrode is perforated, the positively charged atoms pass through these holes and form the so-called "canal-rays." *W. Wien* has found that for these positively charged particles the ratio of the charge to the mass is the same or even smaller than for electrolytes. In other words the canal-rays are produced by "ions" and not by "electrons," the latter being characterized by the large ratio e/m. Real electrons with a positive charge have not been found as yet.

We cannot leave this part of the subject without mentioning other occurrences of electrons. A part of the "Becquerel rays" are of the same nature as cathode rays. These rays emanate as Becquerel first discovered from

certain Uranium salts and they led to the discovery of the new elements Radium (and Polonium?) by Mr. and Mme. *Curie*. These elements send out among others very strong invisible rays which are not stopped even by thin sheets of metal and at first were thought to be similar to "Röntgen rays."

But as soon as *Dorn* and *Becquerel* had shown them to be deflected by a strong magnetic field it became apparent that they belong to the same class as cathode rays. Measurements similar to those described above gave for the velocity of these very penetrating Becquerel rays from 2 to 2.8×10^{10} cm/sec, *i. e.*, almost as large as the velocity of light, while e/m did not differ much from the ratio found for cathode rays. But in this case, and this is of the greatest importance for the development of the electron theory, *Kaufmann has found that the ratio e/m depends for these electrons travelling with such enormous velocity upon their speed,* being the larger the greater the velocity. Another part of the Becquerel rays, namely, those which are easily absorbed and called the -rays, have lately been investigated by *Rutherford* and *Becquerel,* who found their velocity $= 0.2 \times 10^{10}$ cm/sec and $e/m = 6 \times 10^3$. They are therefore very similar to the canal rays and probably positively charged atoms.

Electrons appear however to be much more frequent than in the isolated cases which we have thus far considered. In fact conduction of electricity in gases seems always to be due to the presence of electrons. They may be produced in a number of ways. If you illuminate a charged conductor by Röentgen rays, Becquerel rays, or ultraviolet light, it will lose its charge. Bodies heated to bright red heat or still higher send out electrons. But the most efficient means is through a violent electrical impulse as in the case of cathode rays.

The result of all these experiments is that electrons, or negatively charged particles exist, in which the ratio of the charge to the mass is more than 1000 times larger than it is for a hydrogen ion. A question of greatest importance is: Is the mass of one electron that of an atom, carrying a very much larger amount of electricity than it can in electrolytic action, or is the charge, connected with each particle, the same as that connected with a monovalent ion and is its mass less than the one-thousandth part of that of an hydrogen atom? *J. J. Thomson* has solved this question in a most ingenious way. If a moist ionized, or better, electronized gas is expanded adiabatically the water condenses in drops around the ions as nuclei. If the proper proportion between the water and the ions is chosen the number of water drops equals the number of ions. As *Stokes* has shown, the radius of each drop of water can be measured by the velocity with which a fog formed by the drops sinks down. From the radius and the total amount of water present the number of drops can be calculated. J. J. Thomson found by this method for the charge of each drop, *i. e.*, each electron 1.14×10^{-20} electromagnetic or 3.4×10^{-10} electrostatic units or nearly the same value for each charge as we found for each ion. This charge may therefore be called the smallest quantity of electricity existing, or an atom of electricity; and it may be of interest to know that *M. Planck* has found practically the same number, 4.69×10^{-10} electrostatic units from his theoretical studies on the distribution of energy between

ether and matter. On the other hand it follows that the mass of an electron is smaller than the one-thousandth part of a hydrogen atom. According to J. J. Thomson the so-called ionisation of a gas consists then in a separation of the negatively charged corpuscle, as he calls it, from the remaining part of the atom or molecule, which is left charged positively; in other words positive electrification consists in the absence of these corpuscles from ordinary atoms.

But here the theory cannot stop. A separate mass so much smaller than what we have always supposed to be the smallest and indivisible part of matter, is something so new, that it is natural physicists should have tried to explain away entirely this last trace of matter left in the electrons. And surely in considering the problem before us we must all acknowledge that at least a part of this mass can be only apparent. Let use follow *O. Lodge* in his clear statement of the case, given only a few months ago before the institution of electrical engineers in England.

A moving charged particle is equivalent to an electric current whose strength depends of course upon the velocity of the particle. A magnetic field is set up around an electric current. If the motion starts in *i. e.*, while the charge receives an acceleration, the strength of the magnetic field increases and by electromagnetic induction a counter E. M. F. is produced, which according to Lenz's law acts so as to oppose the action producing the magnetic field, *i. e.*, we have here something which seems to hold the particle back. If the motion is suddenly stopped, induction would tend to continue the motion. We have therefore here something very similar to the inertia of a moving material body opposing mechanical acceleration. But in our case the phenomenon is due entirely to the electromagnetic induction produced by the electrical charge alone, not by mass. It is clear therefore that whatever inertia a moving material body would have due to its amount of matter, it will surely have a larger inertia and therefore a larger apparent mass in virtue of being charged with electricity. *Heaviside* has calculated the energy of a moving charge to be, $Energy = \mu\, e^2u^2/3r$, where μ is the magnetic permeability of the medium, e the electrostatic charge, u its velocity and r the radius of the sphere on which the charge is supposed to be distributed. This kinetic energy measured in mechanical units would be represented by $\frac{1}{2}\, m\, u^2$ where m is the apparent mass, or $\frac{1}{2}\, m\, u^2 = \mu\, e^2u^2/3r$ and $m = \frac{2}{3}\, \mu\, e^2/r$. We may change the expression slightly. The potential of a sphere of radius r in a medium whose dielectric constant is K, is $V = e/rK$, so the apparent mass is $m = \frac{2}{3}\, \mu\, K.e\, e/rK = \frac{2}{3}\, \mu\, K.\, e \times V$. Now the ratio of the electromagnetic unit of quantity of electricity equals 3×10^{10} com. per sec. (*i. e.*, velocity of light) and also equals $\sqrt{\mu K}$. So by denoting the velocity of light by v, we have $m = 2/3v^2\, eV$.

The potential energy of the charge e measured in electrostatic units is $\frac{1}{2}\, e\, V$. But if we have instead of the charge a material particle of mass m moving with the speed of light, its kinetic energy would be $\frac{1}{2}\, mv^2 = \frac{1}{3}\, eV = \frac{2}{3}\, (\frac{1}{2}\, e\, V)$. If a material body having a mass equal to the apparent mass of the moving charge were travelling with the velocity of light, its kinetic energy would be two-thirds the potential energy of the electrical charge when standing still.

Let a sphere be charged to one volt by a quantity of one coulomb. The electrostatic unit of E.M.F. is 3×10^{10} larger than the corresponding electromagnetic unit, but the ratio is just reversed for the units of quantity of electricity, therefore the electrostatic energy corresponding to eV is the same as the electromagnetic energy of one volt-coulomb, namely, 10^7 ergs. Its apparent mass would be $\frac{2}{3}\, 10^7/9 \times 10^{20} = 2/27 \times 10^{-13}$ gr. $= 10^{-11}$ mg., a very small mass indeed. As we saw above, the charge on one ion is 10^{-10} electrostatic units. The radius of an atom is about 10^{-8} cm, so the electrostatic potential of an ion is 0.01 electrostatic units $= 0.01 \times 3 \times 10^{10} = 3 \times 10^8$ electromagnetic units $= 3$ volts. Its apparent mass due to the charge which we may assume as $\frac{1}{3} \times 10^{-19}$ coulombs, is then $m = 10^{-14}.\ 10^{-19} = 10^{-33}$ grams. Comparison with the mass of a hydrogen atom, 10^{-25} grams, shows it is negligible.

In the case of an electron there is however no necessity to assume the radius to be as large as that of an atom, on the contrary it is probable that it is very much smaller than that. Therefore supposing it to be 10^{-13} cm instead of 10^{-8} cm, its potential would be 1000 electrostatic units $=$ 300000 volts, and its apparent mass $m' = 10^{-28}$ grams or about one one-thousandth of that of a hydrogen atom.

The apparent mass of an electron, found experimentally would follow directly from the assumption that the charge is distributed over a sphere of a very small radius and under these conditions, the supposition that the charge is connected to a material particle, is entirely unnecessary. This way of looking at the subject has been strengthened by mathematical deductions and experiments of very recent date. Some time ago it was shown by *Heaviside* that for a charge moving with a velocity smaller than that of light, *e. g.*, the electrons of the cathode rays, its apparent mass will always bear the same ratio to the charge, independent of the velocity, but that the mass would appear larger, if the velocity increases and approximates that of light. Now, as I told you before, the Becquerel rays travel much faster than ordinary cathode rays and reach $\frac{3}{4}$ of the speed of light. So while the cathode rays show always the same ratio e/m we should expect an increase of the apparent mass with the velocity for the Becquerel rays, and this has actually been found by *Kaufmann*.

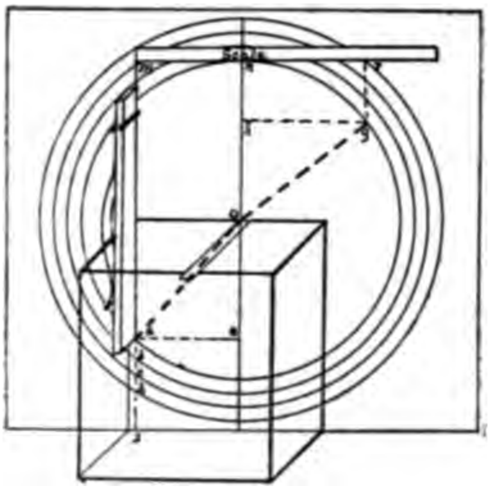
Besides theoretical calculations published a month or two ago by *Abraham*, which were based on the supposition that the so-called mass of the electrons is due only to the inertia effect produced by a rapidly moving electric charge without any mass, led to equations which when compared with Kaufmann's results showed a complete agreement between theory and experiment.

The temptation to extend now these ideas still further is very great indeed. So we must expect in the near future attempts to explain matter as consisting simply of conglomerates of moving electrons, and this would lead us finally to assume as the framework of our universe a continuous ether and imbedded in it the electrons which by the particular manner of combination and motion give rise to the effects we now attribute to matter. The first steps in this direction have been made. Let us hope it is in the right direction and that the electron theory of matter will not in the end prove to be a scientific mirage, which with all our efforts we will never be able to reach.

APPARATUS FOR THE DETERMINATION OF THE INDEX OF REFRACTION OF WATER.

A. O. WILKINSON, DETROIT.

Referring to the accompanying diagram the construction and the working of the apparatus will be easily understood. The apparatus consists of a pine board about 12x18 inches clamped in a vertical position, having several concentric circles drawn upon it. A vertical line is drawn through the center of the circles; to the left of the center, about half of the radius, a line is drawn parallel to the vertical. In front of this board is a rectangular jar whose top is even with the center of the circles. A wooden rod is arranged



to slide inside the jar so that its right hand edge coincides with the line *m s*. A thin metal strip is placed on the jar so that its edge coincides with the center of the circle. The jar is filled with water as full as can be without its couching the metal strip. The lower end of the sliding rod is made to coincide with the intersection of a circle and the line *m s*. By sighting a pin is placed in the same circle so that the end of the rod, the edge of the metal strip, and the pin appear to be in a straight line. The line of the angle of incidence *a e* and of the angle of refraction *h g* can be read on the scale *m r* and the index obtained by dividing the latter by the former. Other trials can be made by using the other circles.

THE INDEX OF THE REFRACTION OF GLASS.

H. N. CHUTE, ANN ARBOR.

For the past sixteen years I have been using what might be termed, by way of distinction, the pin method, of determining the index of refraction of glass. Those who have not tried this method are likely to class it as

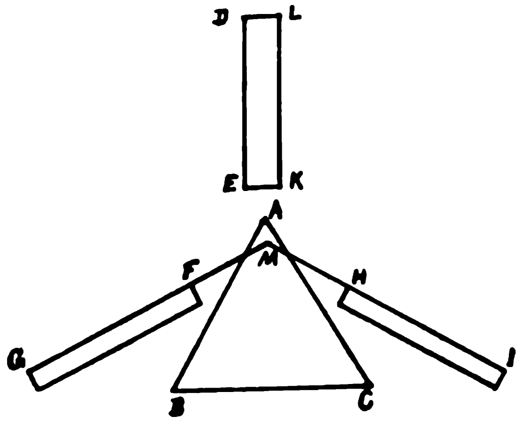


Fig. 1.

crude and not calculated to yield even an approximation. The purpose of this paper is to call attention to the simplicity of the method and to show by an example the degree of accuracy possible. Of late I have been substituting rulers for pins with good effect.

The apparatus needed is a glass prism, three short narrow rulers, a protractor, and a small square board. A sheet of white paper is fastened to the board with thumb tacks.

The first step in the problem is to measure the refracting angle of the prism. The prism, Fig. 1, is placed on end near the center of the board and a ruler, D K, placed at the angle, A, to be measured as shown in the figure. Rotate the board till the light from the window brightly illuminates the edge, D E. Then, place a second straight edge so that its edge, G F, is exactly in line with the reflection of D E seen in the face, A B, of the prism. With a finely pointed pencil draw a line along the edge G F. Now rotate the board to a position in which K L is illuminated and place the ruler H I in line with the reflection of L K in the face A C. Draw the line, H I. Remove the prism and continue the lines G F and H I till they intersect at M. With the protractor measure the angle G M I. Half of this angle will be the value of the angle A in accordance with the principle that the displacement of the reflected ray is twice that through which the mirror surface turns,

since D E may be considered as a ray of light incident on a mirror surface A B which by rotating through an angle A forms the other face, A C, of the prism. The angle G M I thus becomes the angle through which the reflected ray is displaced.

To measure the angle of deviation, mount the prism as before, and place one of the rulers with its edge making an acute angle with the face, A B, of the prism. Fig. 2. Turn the board till the light strikes the edge of the ruler, and then place the second ruler, F G, so that by sighting along F G it seems to be in line with the edge, D E, seen through the prism. The edge,

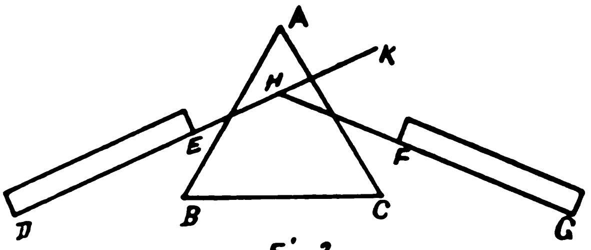


Fig. 2.

D E, of the ruler seen through the prism will be colored with the spectrum tints. Now turn the prism till the edges of the rulers seem to make equal angles with these faces. This may put the rulers a little out of alignment and adjustment of them will be necessary. Draw the lines, D E and F G. Remove the prism and prolong the line G F cutting D E produced at H. With a protractor measure the angle K H G. This will be the angle of deviation.

It is shown in geometrical optics that $\mu = \dfrac{\sin \frac{1}{2}(a + d)}{\sin \frac{1}{2} a}$ in which *a* is the refracting angle and *d* is the angle of deviation. By substituting the value obtained for these angles in this formula, the index of refraction is obtained.

To test the accuracy of the method I applied it to the prism on one of Browning's spectroscopes. The refracting angle of this prism as given by using the instrument to which it belongs is 59° 48′ 20″. Using rulers I obtained the following values:—

119.75
119.50
119.75
119.50
119.50

119.69 ÷ 2 = 59° 48′, showing a difference of only 20″.

The angle of deviation of the F-line as given by the spectroscope is 51° 38′. Using rulers I obtained the following values:—

51.75
51.50
51.75
51.50
51.00
51.25

51.46 = 51° 27′.6, showing a difference of 10′.4, which is in part due to the alignment not being made exactly on the E-line of the spectrum.

Using the spectrometer values the index = 1.657.

Using the method of alignment values the index = 1.656.

The method commends itself for the following reasons:—

1st. The inexpensiveness of the apparatus.

2nd. No dark room is required.

3rd. It is based on the same principles as the spectrometer method, the rulers taking the place of the telescope and collimator.

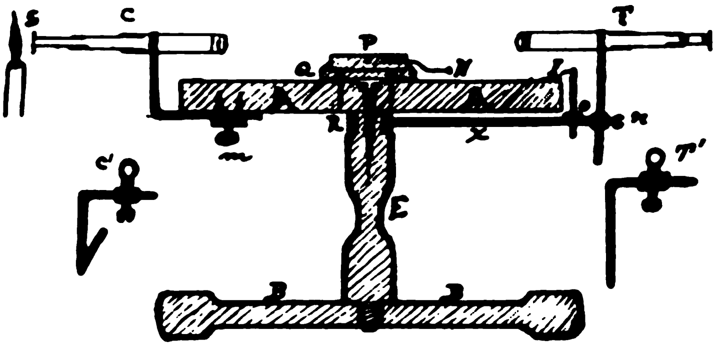
4th. It lends itself to quite a high degree of accuracy.

A SIMPLE SPECTROMETER.

BY CHAS. H. SLATER, PONTIAC, MICH.

A Spectrometer is ordinarily too expensive a piece of apparatus for most high school laboratories to possess. One that answers all the purposes very well may be easily constructed and at a very moderate cost. The base (B B) of the one herein described was the support for an old planetarium long since laid on the shelf. In the absence of one of a similar nature, a base may be easily devised which should be broad and of well seasoned hard wood, the upright (E) being about 12 inches high and 2½ inches in diameter. The top of the upright is turned round 1½ inches in diameter and ½ inch wide. On this shoulder is a closely fitting iron ring (R) into which is screwed a rod (X), the support for the reading telescope (T). The circular disk (A) is thoroughly seasoned walnut 1 inch thick and 13 inches in diameter. A 3-inch screw holds it firmly to the upright (E). A circular scale reading to the fourth of a degree is glued to the rim of disk (A). A prism stand (P) is placed at the center of the disk (A). It consists of a circular plate (P) which rests in a closely fitting piece (Q). An object on the plate (P) can be rotated to any position by the handle (H). The reading telescope (T) has vertical and lateral adjustment so that it

may be easily centered. A small brass pointer (I) is mounted in front of the telescope; it serves the double purpose of a reading index and a partial support for the telescope rod (X). The collimator (c) is mounted on a rod bent twice at right angles (c') and clamped at (M) in such a position that parallel rays from the right (s) will pass across the center of plate (P).



A collimator is obtained by altering a second reading telescope as follows: The lenses in the eye piece are removed and a small metal slit is placed between the aperture and the small shutter in the eye piece. The focal length of the objective lens being found, the tube is then adjusted to that length, clamped in position at (M), centered, and the spectrometer is ready for use.

As to expense: A blacksmith will do the necessary metal work for $1.00 and good telescopes can be gotten for $2.00 each, but they will serve many other uses, as in timing the pendulum, reading the galvanometer, and for showing the construction of a telescope. Every laboratory should have two at least. The circular scale costs 35 cents. Thus any laboratory that possesses the telescopes may obtain a satisfactory spectrometer at an actual cost of less than $1.50. The usual cost of high school spectrometers is from $20.00 to $40.00.

WHAT TO PUT IN A NOTE-BOOK.

E. L. KEELER, CENTRAL NORMAL, MT. PLEASANT.

This is a very important subject and one upon which all teachers of Physics do not think alike. Some think one thing and some another.

Let me ask—what does the note-book do for the student, or rather what should it do? I believe it trains him to observe carefully and accurately; to think sharply and logically, to express with clearness and precision and to formulate exact statements of his results. It fastens the lessons taught by an

experiment firmly in the student's mind and lastly it furnishes a record for future reference or study.

I believe you will agree with me that these are some of the main objects of a note-book and if so it is a very important piece of apparatus for the Physical laboratory.

It has been my observation and experience that the great trouble with the young people of today is the inability to make a good, clear, accurate statement or record of anything. Think of some of the examination papers you received last week, or some of the letters you are receiving daily and I am quite sure they will bear out my statement.

It is just as essential that the pupil be able to tell in a straightforward, accurate and vigorous way what he has done and how he did it as it is for him to do it at all. The note-book should help the student in getting a clear conception of all that the experiment is intended to convey.

The note-book is as important as the experiment itself, but the manner in which some note-books are kept is worse than nothing from the standpoint of Physics and English. Some are lumbered up with useless material and very important data left out. This is one of the serious troubles, if not the most serious one, with which every teacher has to contend. The student must learn to discriminate between important and unimportant data and detail, and the rightly kept note-book will teach this discrimination.

The first thing to be placed in the note-book is the date of the experiment. This should be followed by the number of the experiment, or a brief statement of it. Following this should be the purpose of the experiment which should be stated in simple, clear language, giving the object of the problem or experiment.

If the apparatus is not described in the manual, I would require the students to do it briefly. This will assist them in understanding the experiment. Often a little more than an illusion to the drawing will be sufficient.

This leads me to the question—what kind of a drawing shall be placed in the note-book? Must it be a work of art? Should it be a perspective drawing or sketch? In short, should it be a picture? Most emphatically *no*. Such a drawing has no place in the note-book. The drawing should be limited to such diagrams as are necessary to explain the work. A mere outline drawing accurately done is all that should be required.

When should this drawing be done and when should the notes be recorded in the note-book? To this question there is but one answer and that is, as soon as they are taken. I am opposed to taking rough notes and then recopying them. This is done in too many high schools. The working of the experiment and making a record of the work should not be separated. These two processes should be made one and I do not consider the experiment is complete until a record of it is made.

There is but one time and one place to make this record and that is in the laboratory and at the time the experiment is performed. I feel that this record must be made before the interest is lost, or the details forgotten. If the record is made in this way, I am sure it is not drudgery. The students enjoy it rather than dislike it because they are never behind with their notes.

Require the students to keep their note-books in the laboratory. They are necessary pieces of apparatus for the laboratory. Make the first notes final. Limit everything to the experiment and allow nothing in the note-book that does not pertain to the experiment. Care must be taken that every measuremet and determination is recorded in such a way that the meaning of the data will be perfectly clear and self explanatory, and that the statements conform to the results found in the laboratory.

The form of the record is a very important question. It often determines the interest taken in it by the pupils. The record should be simple and to the point and this is seldom so unless the teacher gives them a model. A point is reached and often times missed when the student endeavors to state it. I have seen students write a dozen lines to say that the diameter of a wire is five milimeters.

I am in favor of representing the data graphically. This method will show the eye the relation between two quantities which are connected, so that any change in the value of one produces a change in the other. For example:—The relation of volume and weight of different masses of the same substance. In introducing the student to the subject of plotting it is desirable that the relation to be represented should be as simple as possible and therefore I think a straight line should be the first one plotted and this implies that one quantity is proportional to the other while a curve implies that the law connecting the two is more complex. It will be seen on account of errors of observation the points will not all lie in a straight line, or a curve, but that they may be a little to the one side or the other. This will point out where mistakes have been made in observation and show where approximate values would be. Such work as plotting curves can scarcely be overestimated and I believe in general we do too little of it.

The argument and operation should contain the entire mathematical calculation by which the results are obtained and the analysis of the steps taken to secure these results. In this paragraph, I would have the theory of the experiment given and a discussion of the error of the result.

Under operation, 1st—A very brief, concise statement of what was done. 2nd—A careful arrangement of the data. 3rd—Interpretation of the data from which arises the conclusion. When the law is proved the students should see the proof of the law in his figures. Many times I have observed students state conclusions drawn from their own knowledge from the text-book and not from their work in the laboratory, or to state false conclusions. These I have found to be quite common in *qualitative* experiments. It is distressing to a teacher to see a pupil make a neat record and then derive a wrong conclusion, or state something that has no connection to the problem.

Let me say in conclusion, First—that the written work in the note-book, when properly done, is splendid training in English besides fixing the experiment better in the students' mind and that it trains the student to express himself, accurately, logically and briefly. Second—that there is one time and one place for the note-book work and that is in the laboratory where the experiment is being performed or shortly after. Third—that the

drawing should be an out-line drawing and never a picture. Fourth—that much work should be done in representing the data graphically. Fifth, and last—that the argument and operation should contain the entire mathematical calculation which should lead to the conclusion and that the student should see the proof of the law or theory of the experiment in his own work.

HOW TO DISCUSS ERRORS WITH PUPILS.

C. H. SLATER, PONTIAC.

The following question and answer is found in an article in School Science some months ago: "What are the characteristics of the training given by laboratory courses? In the first place, the critical faculty is directly stimulated, the observing powers are in constant exercise, and a wholesome self reliance is cultivated." The first reply to this question brings directly before us the importance of a due consideration of the treatment of errors. The pupil very soon finds that most statements in the book are only approximately true under the conditions of his experiment. He observes the effects of varying the conditions of the experiment. Soon, he discovers that greater care and better apparatus lessen the variations from correct values and as a result he gains confidence in his own work, understands his results better, and determines for himself the degree of dependence to be attached to them.

It will therefore be the purpose of this paper to refer briefly to a few of the points to be considered in discussing "Errors" with one's pupils. In a general way, the subject should be outlined and explained by the instructor at the time their first laboratory directions are given previous to beginning that work. As it proceeds, individual attention can be called to errors as specific cases arise. After a half dozen experiments are completed a part of a period at least could profitably be given up to a further discussion of causes, remedies, and kinds of errors, and the benefit to be derived from a consideration of them. The note-book discussion of each experiment should give a good account of such errors as may occur and their effect on the results. This first discussion of errors should by all means distinguish clearly between errors and mistakes. The former can not be avoided; the latter should seldom occur. The one offers an opportunity for improvement, the other is failure. Mistakes have their origin largely in lack of preparation, together with careless, hurried, and impatient work. As a result, it often becomes necessary at first to give a pupil lessons in arithmetic or reading and to ask for repetitions of the experiment. He also observes a class-mate working near by who is more successful because of previous preparation and careful, thoughtful work. Thus the poorly prepared pupil sees half his time wasted, sees classmates go ahead of him and the lesson of avoiding *mistakes* is soon learned. I find also the requiring of a good permanent record

lessens the number of mistakes. On the other hand errors must occur, but they may be made small and some nearly eliminated. The pupil's task is to point out where they arise, to show their effect on the result obtained, and to explain any device or method by which they may be avoided. To enable them to do this I find the following classification to be helpful, viz.: General, Instrumental, and Personal Errors. The most common may be called General Errors which include such as result from inexperience, limited time, poor light, approximating fractional parts of scale units, etc. These may be eliminated in a large measure by the method of averages and by varying the conditions as much as possible. The use of checks at every available place aids greatly in detecting errors and mistakes, one other thing that might be mentioned as a general remedy because of its very healthy influence on the work is to require the finding of the per cent of error in all quantitative work. These general sources of error and remedies as the name signifies apply to all experiments, while the other kinds are more special and must be treated as they arise. Instrumental and Personal Errors are for the most part remedied by special devices of method and apparatus. The former will include such errors as result from crude apparatus, friction, parallax, Capillarity, radiation, etc.

Personal Errors are such as depend to some degree on one or more of the senses, as on touch in the adjustment of the micrometer screw and Vernier Calipers, or on hearing and sight as in measuring the length of a resonant column of air, or finding the laws of vibrating strings. It certainly would be interesting to discuss at some length methods and devices for eliminating these instrumental and personal errors, but they are so well pointed out in our manuals that it will not be necessary to take them up in this paper. As to the value of a consideration of errors, little need be said to the pupil. To him there are several obvious reasons. He judges the accuracy of his own work and sees the advantage of this or that method under such and such conditions. His ingenuity is exercised, while at the same time constructive and careful habits are formed in overcoming difficulties that arise which hinder him from obtaining the desired results.

(a) WHEN AND WHERE SHOULD THE NOTE-BOOK BE WRITTEN? (b) CORRECTION OF NOTE-BOOKS.

L. M. PARROTT, SAGINAW.

The topic as assigned involves two thoughts. I cannot *answer* either of them. In the few moments allotted me, however, I will but briefly attempt to present the method I have followed and then throw it open for discussion.

Two days before his laboratory period each pupil is told the number of the experiment he is to work, and is expected to have both himself and note-book prepared when he enters the laboratory, so that he can immediately attack his problem by a straight from the shoulder method. At the begin-

ning of the laboratory period he is handed one of the printed forms indicated below, and all his data is recorded in duplicate, in his book and on this form, exactly as taken. This duplicate is left with the teacher, all the calculations being indicated below the recorded data and as much worked out as time permits. Then, during the coming week, each pupil in the quiet of his own home must write a discussion of his experiment, bringing out its purpose, the principles involved, his observations, manipulations, conclusions, etc., in the very best literary style of which he is capable.

SAGINAW, EAST SIDE, HIGH SCHOOL.

PHYSICAL LABORATORY.

......................190..   Experiment No..........

APPARATUS:
.... No..........
.... No..........
.... No..........
.... No..........

Calculations:

....

These data sheets enable the teacher to keep in close touch with each student's progress, and a daily record of what has been attained. Each is carefully looked over, the character of the data taken and the indicated calculations outlining to a large degree what the pupil has acquired from the experiment. Once a month the books themselves are put in the teacher's hands and the discussions are carefully read, marked, and points noted for consultation with the pupil.

A METHOD FOR DETERMINING THE DENSITY OF GASES.

F. R. GORTON, YPSILANTI.

That air has weight may be ascertained by the use of an incandescent lamp bulb and a balance that turns easily with 0.1 gram. The bulb is first counterpoised by means of shot or sand. Air is then admitted by inserting a nail in the neck of the bulb and tapping it lightly with a mallet. The end of the tube C shown in the figure is thus broken off and every fragment caught in the bulb. On replacing the bulb upon the balance a gain of nearly 0.2 gram is shown.

In order to ascertain the density of air, it is advisable to remove the brass fixture attached to the bulb and clear away every particle of cement. The bulb is then weighed as accurately as possible. Dry air may be collected in a small gas bag, from which it is admitted into the bulb by a T-tube arranged as shown in the figure. The rod D extends through the tube projecting at the ends. The joint A is made air tight by means of rubber tubing. At B a piece of tubing causes the glass tube to make an air-tight connection with the bulb N. If the inlet pipe is now connected with the gas bag, a tap upon the rod at D will break the bulb at C and admit air from the gas bag. The gain in weight having been found, the volume of air admitted is determined by filling the bulb with water of known density and weighing.

The density of other gases is found by filling the gas bag with the dry gas whose density is required and admitting it in the same manner.

AN EXPERIMENT FOR ILLUSTRATING OSMOTIC PRESSURE.

C. F. ADAMS, DETROIT CENTRAL HIGH SCHOOL.

It is well known that the walls of many plant cells form "semi-permeable" membranes. Such membranes allow diffusion of certain substances through them in one direction while not permitting diffusion in the opposite direction. Dr. Louis Murbach, of our school, first called my attention to the use of the carrot and other similar vegetables for the purpose of illustrating osmosis.

To perform this experiment a hole is bored along the axis of a large, sound carrot, about 10 cm. deep and 2.5 cm. in diameter, a carpenter's bit being used for the purpose. I also peeled the carrot up to its crown, although I suspect that this is unnecessary. The cavity in the carrot is then nearly filled with sugar and water added to it to within a centimeter of the top. To close the cavity a two-hole rubber stopper is used, in one hole of which is inserted a long piece of barometer tubing having a bore of about two millimeters. After the stopper is driven firmly into the carrot the other hole in

the stopper is closed by a glass plug. There should be sufficient water in the carrot to entirely fill the cavity so that the insertion of the glass plug will force the water a centimeter or so up the tube. The carrot and tube are then supported by a clamp so that the carrot stands entirely submerged in a dish of water. If care has been taken to put the apparatus together so that there is no chance for leakage the liquid will immediately begin to rise in the tube.

At my first attempt with this experiment the liquid rose to the top of a tube 130 cm. long in two hours and a half. I filled the same carrot again lengthening the tube to 308 cm. and allowed it to stand during the night. In the morning the current was still upward while a trail of thick syrup on the outside of the tube showed that the sugar solution had run over during the night. I again connected the same carrot by a U tube to a bottle filled with mercury and the mercury was forced up a tube 63 cm. when on my attempting to move the apparatus a leak occurred and put an end to the experiment.

As the osmotic pressure of a saturated solution of sugar is known to be several atmospheres I would suggest that one might in this way force the mercury up to a considerable height. Possibly it would be found advantageous to bind the carrot with cheese-cloth to prevent its bursting, and the stoppers would certainly need to be fastened in place. I hope to hear that someone has taken the matter up and secured interesting results.

GAS GENERATOR.

PRINCIPAL JOHN P. EVERETT, PONTIAC.

When I began teaching physics at Grass Lake I met with a difficulty usually encountered in small places—no gas for laboratory purposes. The matter seemed of sufficient importance to warrant some attention, and the apparatus herein described is the result. For the main ideas embodied in constructing the generator I am indebted to Dr. Chadwick. My work was rather one of adaptation than of invention.

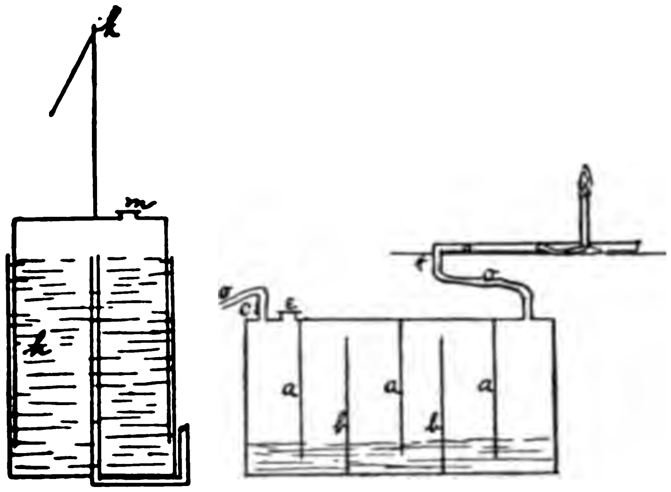
The operation of the generator depends upon the fact that an inflammable gas is generated by pressing air through gasoline. The actual generator consists of a galvanized iron box 12 in. x 10 in. x 7 in., a longitudinal section of which is shown in the accompanying diagram. Let down from the top and soldered to the sides are three partitions (a) which reach within half an inch of the bottom. Two partitions (b) extend from the bottom to within half an inch of the top. Gasoline is introduced by means of an air-tight cap (e). The bottom should be covered from one to two inches. Even distribution is secured by tipping the generator on its side and righting it by turning on its longitudinal axis. If air is forced in at (c) it must pass through gasoline three times and emerges at (d) a highly inflammable gas.

The required air pressure at (c) is afforded by the common arrangement of two cylindrical tanks (h), the lower being filled with water. I used

tanks about three feet in diameter and of a height equal to twice the width of galvanized sheet iron. The upper tank must be weighted. A triple pulley (k) fastened to the ceiling was used in raising the tank. Air is admitted as the tank rises by removing the cap (m).

For conducting the gas from the generator I used a half-inch gas pipe (t) running along the back of a bench. Into this pipe were let ordinary air cocks for attaching the rubber tubing leading to the burners. Since the generator must be moved each time it is fillled, connection with it is made by flexible rubber tubing (o).

The flame is quite similar to that obtained from ordinary coal gas. It can be made luminous or non-luminous at will. The Bunsen burners, however, with some modifications, can be made to work very well. The opening through which gas is admitted to the base of the burner must be enlarged and the holes at the side of the tube for admitting air should be quite small. This I accomplished by slipping a perforated paper between the movable collar and the tube.



This generator is to be commended (1) for its cheapness. Twenty dollars will provide an elaborate apparatus, while a serviceable one can be constructed for much less. (2) It can be made at any tin shop. (3) It is safe. The flame cannot be drawn back to produce an explosion. I demonstrated this by experiments in the open air. (4) Its operation is economical. One gallon of gasoline will last for weeks. (5) There is no large volume of gas stored to leak and cause trouble, and no gas is generated except as needed. The apparatus is rendered absolutely inoperative by tying to a peg the rope leading from the pulley (k).

Note.—Since the meeting of the Schoolmasters' Club I have learned that burners are now manufactured which are especially designed for the gasoline flame. They can be obtained of houses dealing in laboratory supplies.

COEFFICIENT OF LINEAR EXPANSION.

C. S. COOKE, DETROIT CENTRAL HIGH SCHOOL.

The idea for the form of apparatus herein described was suggested to me by N. H. Williams, Shortridge High School, Indianapolis. After experimenting for some time with different pieces of apparatus for measuring the coefficient of linear expansion, I can safely recommend the one described below for its simple construction, small cost and reasonable accuracy, considering the several sources of error incumbent on any coefficient of expansion piece. Where there are several similar pieces of apparatus to be set up for a laboratory section, the time saved by having apparatus of simple construction is of considerable importance. With most pieces some electrical device is used for obtaining the expansion. Such devices are often unreliable in the hands of the pupil. Often times the frame work for supporting the metal tube or rod will expand with heat or moisture, thus introducing errors into the result. In this piece there are no troublesome electrical contacts and it is comparatively free from the other difficulty mentioned. With the piece described it is possible for the pupil to obtain several readings during the laboratory period. We have observed that results obtained by pupils are uniformly better than with any other apparatus we have tried.

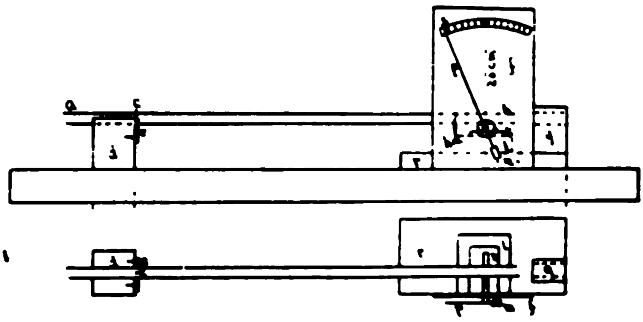


Fig. 1

Fig. 2

The apparatus consists of a brass tube (ab) about one meter long (Fig. 1) whose expansion is to be measured. One end of the tube rests in a grooved block (d) while the other end rests on a small brass roller (i) which carries the slender pointer (p). (m) is a counterbalancing weight. The roller rests on a piece of ground glass (k) which in turn is mounted on a block of wood (1). (1) is fastened to a small board (r). The ground

glass prevents slipping of the roller. (f) is a piece of cardboard or sheet metal fastened to the baseboard (r). The pointer moves in front of a scale (s) graduated in centimeters. The blocks (d) and (r) are firmly clamped to the table. A piece of gas tubing connects at (a) with a steam or cold water supply. The tubing at the other end passes through a hole in the block (g). This is to permit handling of the outlet tube during the experiment without disturbing any adjustments. The brass tube is kept in firm contact with the roller by a rubber band fastened to a tack at (h). The expansion takes place from the fixed point (c). A small pin passes through the tube and projects about 2 cms. of an inch from the under side and is securely clamped to the block (d) by a brass piece (e).

As the tube expands, the amount of expansion is measured off on the surface of the roller. This expansion bears the same relation to the movement of the end of the pointer that the diameter of the roller bears to the length of the pointer; thus in figure 2, E : S : : d : p. The shifting of the center of rotation introduces no error that is measureable.

We have tried covering the tube with a jacket to prevent errors by radiation, but do not find that the precaution is of any particular value.

The following tabular form shows the method of recording data and calculating results:—

Length of tube in cm	83.4 cm.
Diameter of roller (measured with micrometer screw)	.2402 cm.
Temperature of the water (taken at outlet)	$3^\circ.8$ C.
Temperature of steam (computed from barometer)	$99^\circ.72$ C.
Change of temperature	$95^\circ.92$ C.
First position of the pointer	1.00 cm.
Second position of the pointer	13.49 cm.
Change of position of the pointer	12.49 cm.
Expansion (x : 12.49 :: .2402 : 20)	.1500 cm.
Expansion per degree	.001574 cm.
Expansion per degree per unit of length	.00001887 cm.
Accepted coefficient of expansion	.00001875 cm.

Error .00000012. Percentage of error, .6%.

SOME PHENOMENA OF HIGH FREQUENCY CURRENTS.

BENJAMIN F. BAILEY, ANN ARBOR.

The fundamental principle upon which the operation of high frequency apparatus is based, is the fact that the discharge of a condenser is usually oscillatory in character. In other words, if a condenser is charged and then allowed to discharge through a piece of wire, the current instead of flowing

steadily in one direction until all the energy is expended, oscillates rapidly back and forth a number of times. The case is precisely analogous to that of a pendulum or of a spring suddenly released from pressure.

Thus in Fig. I and II if we imagine an electric current, flowing in the circuit of I, and the pendulum in motion in II, the analogy between the cases is very striking. Thus the electro-motive force, driving the charge into the condenser (equal to Q C) corresponds to the force pushing the pendulum to one side (equal to $k\ s$). The back force due to acceleration $m\ (d^2q \div dt^2)$ takes the place of the back $E.M.F.$ due to self-induction $L(dq^2 \div dt^2)$, and the force due to friction $K_2x' = K_2(ds \div dt)$ that of the $E.M.F$ due to resistance $RI = R(dq \div dt)$. Indeed the equations for the two phenomena are identical, and we can calculate the period of vibration of one as easily as that of the other. The theory is too long to give here, and I shall merely give two results of it.

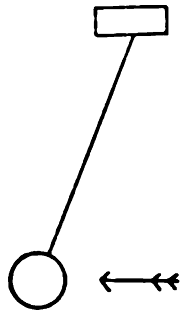


Fig. II.

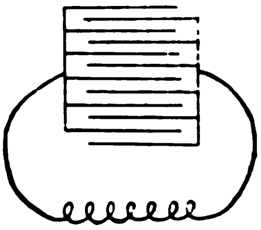


Fig. I.

One is that the period of one complete vibration of such a system is given by $T = 2\pi\sqrt{LC}$ comparable with $T = 2\pi\sqrt{(e \div g)}$ in the case of a pendulum), and the other is that in order to have any oscillation at all, it is necessary that the resistance be less than $2\sqrt{(L \div C)}$ just as in the case of the pendulum no vibration at all will take place if the viscosity of the medium in which it moves is too great.

The arrangement of the apparatus may be made in various ways, but the most usual set-up is as shown in Fig. III. T. is an ordinary alternating current transformer, charging a current of 50 volts and 120 complete cycles per second, to one of about 5000 volts, and of course the same frequency. This charges the condenser C with a certain quantity of electricity 240 times per second. In Fig. IV let the sine curve represent the variations of $E.M.F.$ across the terminals of this first step up transformer. At the point a there is no $E.M.F.$ applied to the condenser and consequently no charge in it. As the voltage increases along the curve $a\ c$ the charge in the condenser also increases, and we finally come to the point b where the voltage is great enough so that the air gap g (Fig. III) breaks down, and allows the condenser to discharge through the primary L of a second step up transformer T_r.

This circuit of the condenser the spark gap and the primary of the second step up transformer is like that of Fig. I except for the resistance of

the spark gap and the discharge is consequently a high frequency current. This current is represented by *bdc* in which the length of the oscillations is greatly exaggerated on account of the difficulty of drawing them sufficiently close together. The number is probably greater than is shown there. From the secondary of this transformer we can draw a current like that in the primary except that the voltage is increased about 50 times, and the current decreased in the same ratio. This gives us in this particular machine a current of a frequency of 435,000 double vibrations per second, a voltage at the highest ordinate of 350,000 volts, and an average current of about half an ampere. This is a far greater output than can be obtained from an ordinary induction coil of the same size. The spark discharge produces a regular roar, so great is the volume of current.

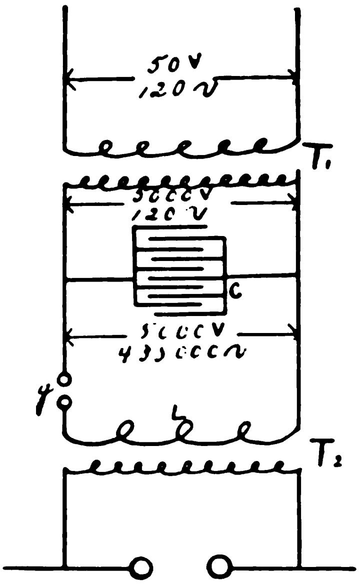


FIG. III.

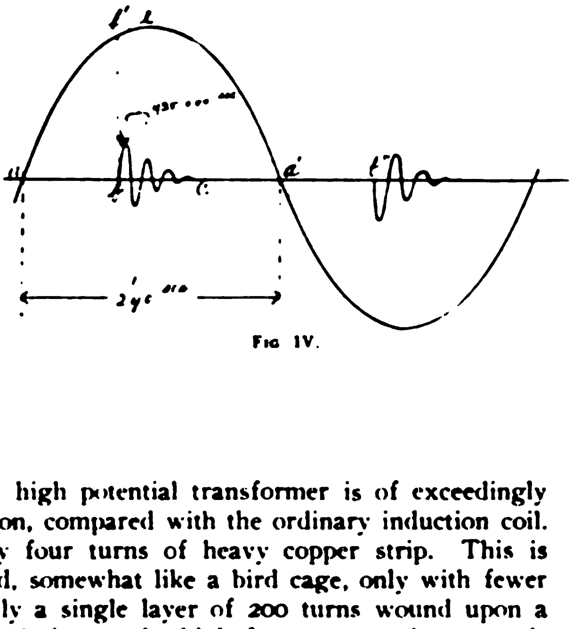


FIG. IV.

The high frequency and high potential transformer is of exceedingly curious and simple construction, compared with the ordinary induction coil. The primary consists of only four turns of heavy copper strip. This is wound upon a frame of wood, somewhat like a bird cage, only with fewer bars. The secondary has only a single layer of 200 turns wound upon a frame within the other one. Owing to the high frequency no iron core is needed; indeed its presence would be a serious detriment. Only about 350 feet of wire is used for the secondary, in comparison with about five miles which would be used in an ordinary coil of like voltage. The whole is immersed in oil to provide good insulation.

There is some liability of an ordinary alternating current arc forming across the gap *g*, and to prevent this a motor is used to rotate a toothed disc to break the arc., An air blast is sometimes used for the same purpose. The coil works nearly as well, however, with a plain spark gap.

We can now examine a little the results of our two equations. Taking the one for the minimum value of the resistance, $R < 2\sqrt{(L \div C)}$ and substituting the value of the self-induction and the capacity, we reach the interesting conclusion that the R is less than 17.2 ohms. Thus the actual resistance of the spark gap is certainly less than 17 ohms and is probably much smaller yet. To figure the frequency is quite simple. We have merely to substitute $T = 2\pi\sqrt{(L \div C)}$ and get for a result $T = \frac{1}{435{,}000}$ of a second or we have 435,000 complete vibrations per second. This enormous frequency is the distinguishing characteristic of the current, and is the cause of many strange effects.

Perhaps the most curious of these are its physiological effects. If we pass an ordinary alternating current through the human body, all the average person can endure without excessive pain is about 0.015 of an ampere. The resistance of the body from hand to hand between dry metal electrodes is about 2500 ohms. Then since the power expended is given by I^2K we have $0.015^2 \times 2500 = 0.56$ watt. In other words about half a watt of power applied continuously in the form of an alternating current of ordinary frequency is about all the human body can endure. What do we find to be the case with the high frequency current? As far as I can find nobody has ever constructed a machine capable of giving all the current a person can endure, so what the limit is we do not know.

The largest amount anyone has used as far as I can find out is 1.5 amperes, which is the maximum amount Elihu Thompson could obtain from his large machine. This means $1.5^2 \times 2500 = 5600$ watts or just one thousand times the amount of power that can be endured in the form of a low frequency current.

This is certainly a very surprising result, but it is not the worst of the case. By reference to Fig. IV it will be seen that there is an interval from c to b'' during which there is no current. Now the 1.5 amperes is the average (strictly speaking the $\sqrt{\text{mean}^2}$ value, but practically the average) value of the current during the whole time, and it is obvious that during the time from b to c it must be larger than this average. Still more, if we take the maximum ordinate as at d, it will be very much greater than 1.5 amperes. Just how much greater this is it is hard to say, but in any particular case we can approximate it so as to get at least an idea of the ratio. The argument is too long to give here but it leads to the surprising result that with an average value of 1.5 amperes the maximum value of the current is probably about 21 amperes. There are numberless theories regarding the harmlessness of these currents, but nothing is certainly known about it. The fact simply remains that there is not time between the very rapid oscillations for the muscles to respond and produce the painful contraction which is characteristic of the alternating current of low frequency. Also there is no electrolysis which is probably responsible for the painful effects of the direct current.

Another surprising property of these currents is the facility they give for what might be called "wireless lighting." If a glass globe, exhausted to the proper degree (a common incandescent lamp bulb will do, but a Geisler tube is better), be held near the high frequency coil, it will light up in much the same manner as though the discharge from an induction coil or a static machine had been passed through it. There need be no connection whatever between the tube and the coil. This is easily understood if we consider what would happen if we held a loop of wire in the same position. Some of the lines of force from the transformer would pass through the loop, and by their rapid change of direction would induce oscillating currents in the loop. Precisely the same thing occurs when we hold a bulb of rarefied gas there. Oscillating currents are induced in the gas in the same way, and it is these currents that cause the gas to light up.

This is an illustration of electro-magnetic induction. The same result can also be obtained by electro-static induction. If we connect the two discharge rods to two metal plates, suspended about a foot apart, we create between them a rapidly alternating electrostatic field of force. This is here called electro-static by courtesy only as it is in reality far from static. If we now hold or suspend a globe of rarefied gas between them, at one instant one plate will be positive, the other negative. By the law of attraction the + plate will attract — electricity to the end of the tube nearest it and repel + electricity to the other end. An instant later (in the case of the machine referred to $\frac{1}{870,000}$ of a second later) the conditions will be reversed and all the electricity attracted to the left of the tube must rush over to the right, and that on the right go to the left. This continues and thus an oscillating current is set up in the tube which causes it to light up.

As regards the application of high frequency currents in practical engineering, the outlook is not encouraging. There is no doubt but that such a system could be made to work (using the ordinary incandescent lamps in the usual manner, and not as described above), but several disadvantages would appear. The high frequency would make trouble on account of the capacity and induction effects, and the regulation would consequently be bad. The only saving would be in the cost of transformers, which, as was said before, would need no iron and very few turns of wire, and consequently could be built very cheaply. This is a comparatively small matter, however, and there is no likelihood of such an application in the near future.

Proceedings

OF THE

Michigan Schoolmasters' Club

AT THE

Thirty-Ninth Meeting

HELD IN

YPSILANTI, March 31, April 1, 2,

1904

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Michigan Schoolmasters' Club

PROCEEDINGS OF THE THIRTY-NINTH MEETING, HELD AT YPSILANTI, MARCH 31, APRIL 1, 2, 1904

PAPERS

EDITED BY THE SECRETARY

GENERAL MEETING

SOME PROBLEMS IN EDUCATION.

PROFESSOR J. M. COULTER, UNIVERSITY OF CHICAGO.

Never in the history of education in America has there been such a universal movement towards change as now. Conscious that existing plans must be modified, all who are interested in education have a feeling of great unrest, and this feeling expresses itself at every educational conference. Discussions are endless, and often apparently fruitless, for opinions are as numerous as are the factors of the problem, and the mighty power of what has been over the frail form of what might be holds us with a death-like grip.

It is not probable that some great educational reformer will arise and lead us directly to the truth. In these days we are all searching for the truth so eagerly that it is not likely to come as a sudden revelation. It will probably come by a series of approximations, and it will not be recognized until it has been thoroughly tested; and when it is known and acknowledged no one can tell who has been responsible for it, for it will have been evolved gradually from all our former experience. There is no problem concerning which we can so ill afford to be dogmatic; and no one concerning which we are so dogmatically inclined. There is no question concerning which past experience may be so unsafe a guide, since what we have attained cannot be compared with what we hope for and have a right to expect. There is no problem in which theorizing may lead so far astray, and no problem which

has been so covered up with crude theorizing. We do not understand the structure we are seeking to modify and develop; we do not know what we want to do for it when we shall understand it; and we do not know how to accomplish when we shall know what we want. Out of this mass of negations we are constructing our hypotheses, and even venture to hope that they may stand. That student of education has not advanced very far into his subject who has any great measure of confidence in his own opinions, or in those of any one else. The effect of all this should be, not a discouraged, but a receptive mind; not dogmatism, but liberality. There need be no expectation that the true education is just at hand, and those impatient souls who cannot rest content until everything is settled must cultivate the scientific spirit, which has learned to labor and to wait. It is no less a fact, however, that the true education is nearer at hand than it was last year, and that its coming will be hastened in proportion to our dissatisfaction with the existing order of things, and our rejection of that mind benumbing dogma that the past contains all that is best in education. Our educational growth should be like that of a vigorous tree, rooted and grounded in all the truth that the past has revealed, but stretching out its branches and ever renewed foliage to the air and the sunshine, and taking into its life the forces of today.

With such a preface it may seem rash to suggest anything, but all of us must keep suggesting, if it is only the suggestion of a doubt. The subject announced is broad enough for me to select what I choose from the mass of educational problems that are constantly presenting themselves. If any of those which I have selected, or even all of them, do not seem pertinent to your situation, you must understand that for some reason they have forced themselves upon my attention.

The first problem I would suggest is:

1. *The act of teaching.*—This is quite independent of the subject-matter and has no reference to the equipment of the school in material things. It concerns simply the contact of teacher and pupil in the act of teaching. Perhaps the most difficult work of the teacher is to appreciate the exact mental condition of the pupil in reference to any subject. Unless there is complete adaptation in this regard the contact is a failure, leading to mutual disgust and distrust. It has been my good fortune to witness a large amount of teaching in all grades, and the impression left upon me has been one of astonishing lack of simplicity and directness in the presentation of subjects, resulting in utter confusion. My own conclusion has been that this indicates either ignorance of the subject, or lack of teaching ability, or a wooden application of some pedagogical refinement which has been learned somewhere, and which is either not worth applying in any case, or is woefully misplaced. Hardly can there be imagined a worse combination than wooden teaching by one ignorant of the subject. In a great mass of teaching, instead of using clear expression and a direct presentation, the effort seems to be to use most unusual phrases, as far from an ordinary vocabulary as possible, and to approach the subject in such a devious way that its significance is in danger of being missed. The philosophy of teaching is well enough as a background, but philosophical teaching is usually out of place. To inject

the abstractions and phrase-making of normal training into the school room is to dismiss clearness and all intellectual contact with pupils. This is no criticism of pedagogical training, for I would be the last to suggest that any profession should be attempted wihout professional training; but it is a criticism of those teachers who do not know how to apply their training, and follow what they regard to be rules, rather than principles. Probably the greatest factor in this result is the fact that far too many teachers have learned the form of teaching merely, and have strangely neglected to gain some knowledge of the subject-matter to be taught. With them it is form without substance, and what else are they equipped to do but to go slavishly through the motions of teaching? There is no flexibility, no power of adaptation, no ability to depart from a fixed routine, and hence no adjustment to the very diverse mental conditions they must meet and are expected to stimulate. Necessary flexibility in methods is impossible without a broad grasp of the subject to be presented. It should be unnecessary soberly to state that methods of presentation amount to nothing without something to present, but the schools seem to need the statement. The amount of meaningless drudgery that this senseless formalism has forced upon pupils has long been recognized by parents, whose indignation occasionally breaks out in condemnation of the schools as places where method has run to seed. It is very fortunate that the human mind is so tough a structure that it will develop in spite of teachers, and all of our educational experiments have not succeeded in sensibly stunting it. I have about concluded that the great problem in the act of teaching is not how to impart instruction, but how to oppose the fewest obstacles to mental development. The human mind has a mighty way of overcoming obstacles, but, as teacher, we have no right to attempt to make them insurmountable. I have almost cried out in indignation when witnessing some pupil whose quick mind has discovered short cuts to results, ruthlessly forced upon the procrustean bed of method by some teacher who knows only one way. It is such things that bring the profession into deserved contempt, as one that has not yet emerged from blind empiricism.

The necessary combination of knowledge of the subject with knowledge of methods needs further emphasis and application. It is often supposed that the lower the grade or the more elementary the subject, the less the need of a knowledge of the subject on the part of the teacher. There can be no greater mistake if successful teaching is the end in view. In no part of educational work is flexibility in presentation and in material so necessary, as at its very beginning. Truth is many-sided, and it is always a question as to which side shall be presented. The teacher who only knows one side is hopelessly lost, and hence becomes dogmatic and useless. For instance, I know of no science teaching that demands a broader grasp of the subject-matter, and a more facile adaptation of material to purpose, than "nature study" in the lower grades. So long as it is committed to teachers with no scientific training, I predict that it will be a failure. It is in danger of becoming worse than a failure, for to atone for lack of scientific knowledge teachers are apt to have recourse to popular books upon science, full of sensational and claptrap statements, and actually mislead those whom they

are guiding. To escape from the bondage of the book, to see with our own eyes, to handle with our own hands, to judge for ourselves, cannot be brought about by the retailing of romances. Even if the teacher has enough of the scientific spirit, to say nothing of sufficient knowledge, to discard the romances, the overwhelming danger is that the pupil will be set at dead work, which when done leads to nothing. Observation merely for the sake of obervation is cruel when the world is full of important things to be observed. But how can a teacher select the important things and discard the trifling things without some fundamental knowledge of the subject? The whole race of man is peculiarly open to humbugging in the guise of science, and this will be intensified if school children are to be humbugged by their teachers. I have used as an illustration a subject with which I happen to be familiar, but fancy that it is but an illustration of all the rest. Not to prolong the discussion of this particular problem, it is my desire to impress the fact that the act of teaching demands a knowledge of subjects as well as of methods, that there may be the greatest amount of flexibility in presentation; it demands simple language and a very direct style; entire suppression of the philosophy of a subject until there are facts enough upon which to found a little simple philosophy; complete abolition of all pedagogical cant; and a reverence for truth that will not permit it to be trifled with in order to arouse a factitious interest.

My next problem is much more special, but it has long been a troublesome one, and has a certain logical connection with the one already considered. It is

2. *Science in secondary schools.*—Probably no subject has been more discussed than this one, and it seems well-nigh threadbare. School-teachers and university teachers, in committees and conventions and addresses and periodicals, have wrestled with this problem. The school-teachers knew their pupils and their facilities, but not too much about the subjects. The university teachers knew the subjects but very little about the pupils, and still less about the facilities. It was hard for both to occupy the same standpoint, and both were inclined to be somewhat dogmatic, the university-teacher, perhaps, a little the more so. School patrons with their demands have been a factor also. The result is what you see, and very far from satisfactory, for neither university-teachers, nor school-teachers, nor patrons can be said to be satisfied. There seems to be well nigh general consent to reduce the number of subjects masquerading under the name of science, to restrict them to a few fundamental ones, to increase as much as possible the time devoted to each one, and to insist upon the laboratory as an essential adjunct. This is advancing very far in what we believe to be the right direction, but it is more an advance in opinion that in practice. It does not become me to particularize concerning all the sciences, but I wish to make a few suggestions concerning that one with which I am identified, and the principles stated may be capable of application to all the rest.

Among the fundamental sciences botany finds a prominent place, as presenting material everywhere present and easy to handle, as entering largely into our every day lives, as peculiarly adapted to serve the variety of pur-

poses in view in a science study. As this science has been revolutionized within a few years and is still in a period of extreme revolution, the schools have found themselves strangely at variance with the universities, and are plainly and repeatedly told that their botany is an absurdity. These unpleasant statements are usually received with becoming meekness, as coming from those who are supposed to know, but have led to nothing or to chaos. The ancient type of botanical teaching, lineal descendant of the time when botany was regarded as more æsthetic than scientific, was to regard the flower as the only material worthy of examination, and the name of the plant which bore it as the ultimate fact to be learned. All consideration of plant organs was limited to their usefulness in helping to obtain some trace of this all-important name, and botany became a somewhat elaborate game of hide-and-seek. Interested publishers supplied the school with "analytical keys" for chasing the delusive name; ingenious teachers and others devised analytical blanks, in which the fleeting observations could be set down, and by which all impertinent observations could be suppressed and the observer turned into a counting machine; herbariums began to be demanded, whose value was measured by the names tagged to the specimens. Is it a wonder that botany came to be regarded as a collection of not especially attractive names? There is no doubt that such work found a ready interest in certain pupils, and that botanists have been born out of just such conditions: but the chief complaint is that this is not botany. It holds about the same relation to botany as does a collection of postage stamps to geography. The universities, after they had learned a little botany themselves, rose up and condemned this masquerade, and the universities did well; but what did they seek to substitute for it? The schools were told that a laboratory must be equipped with compound microscopes; that botany could be seen only by peering through a lens; that all the plant groups, from the lowest to highest, especially the lowest, must be passed in review. It was urged that by this method alone could there be gained any proper conception of the plant kingdom. The schools, as many as could command the specified equipment or believed in the advice, made the change. Young men and young women fresh from university laboratories were called upon to direct the work, and the schools waited to be revolutionized. It was of intense interest to me to watch the result, since my own voice was as loud as any in recommending the change, and it had the entire consent of my judgment. Numerous new books appeared, both text-books and laboratory guides, the favorite legend being "for high schools and colleges"; this time written by the college men, and, as the school-teachers soon learned, from the college standpoint, which calculates upon time and equipment and a reasonable amount of intellectual maturity. The schools began the struggle and they have been struggling ever since. I have visited numerous high schools to inspect their work in botany, schools that contain the best possible facilities for this kind of work, and I wish to give the result. Taking an excellent school as an example, I found it equipped with laboratories that put to shame those of many colleges, and the work in charge of thoroughly trained special teachers, competent to get the best results possible. The plant kingdom must be presented

in four or five months. The congested state of the schedule, however, a perfectly normal state in secondary schools, permitted only two exercises each week. Some thirty or forty exercises, therefore, of one or two hours each, represented the actual time at command. It should be said that the instructors rebelled both at the time and the field to be covered, but a Juggernaut system must override all such protests, and the result must be demanded without any reference to conditions. The plant kingdom, therefore, was marshalled through its representatives; fleeting glimpses of unknown and unrecognizable things were obtained through the microscope; that most difficult art of interpretation, without which the microscope is but a delusion and a snare, could not be cultivated; a rapid succession of unrelated objects, becoming increasingly complex and hence more difficult of interpretation, was presented in bewildering haste; the brief lectures dealt with the most fundamental and philosophical truths of biology. At the completion of the course I conferred with several of the brightest pupils and sought to discover their knowledge of the plant kingdom. It was simply confusion. Undoubtedly, there are a few favored schools where a more liberal management can show better results, but I believe that the result given is the general one. Therefore, I am ready to confess, contrary to my former honest conviction and earnest contention, that the universities made a blunder in their advice. The old method was very narrow, and very superficial, but it gave a certain kind of contact with nature. The new method is broad and philosophical, but it withdraws pupils from contact with nature and makes botany a thing of the laboratory table and the microscope. The latter needs time and some maturity, as well as equipment, to develop. There is still another phase of botany, which is coming rapidly into prominence and which is reaching sufficient organization to be utilized by the schools, which I believe is destined to be the field cultivated by secondary schools. It has all the breadth and philosophy of the morphological work that is being attempted, and a much more rational contact with nature than the old method of so-called "analysis" brought. While it is often claimed that studies are merely tools, to be thrown aside when the result has been obtained, there are certainly some subjects at least in which the content as well as the discipline is to be considered. It is very important, for example, that the pupil at some time shall come into rational contact with the phenomena of life, as presented by plants or animals or both, and this quite apart from the discipline such study is adapted to afford. These phenomena enter too much into the necessary experience of everyone to be disregarded in schemes of education. It is such a contact that the new botany brings. Plants are regarded as living things, performing a variety of operations, sensitively adapting themselves to varying external conditions, associating themselves into communities of various kinds, occupying a definite place in nature. This mass impression of plants as a whole, and of the conditions which determine their distribution and association, is the fitting introduction to more detailed study. The main trouble with the morphology work of our schools to-day, and of many of our colleges as well, is that the structures observed cannot be related properly. There is no background upon which the

details can be projected. The substitution of intelligent field-work, not collecting, for some of the laboratory work, the introduction to plant societies and the recognition of their peculiarities, the constantly deepening impression that plants are things which work as well as exist, which perceive and having preceived respond, must certainly commend itself as resulting in a worthy primary impression of the plant kingdom. It is not the superficial search for so-called flowering plants and their names; it is not the monotonous treadmill of morphological work and microscopical examination; it is that which gives significance to both, and introduces plants as living, sensitive, responsive organisms; not scattered at haphazard, but organized into communities with all sorts of mutual relations, and giving significance to every landscape; not passive and helpless, but exceedingly active and able to take care of themselves; not things to be used and admired merely, but also the great revealers of those fundamental laws of biology whose study is to lead us eventually into the deepest recesses of knowledge. The principle involved is to lead to a correct impression of general truth by means of personal contact, from which advance in any direction may be made. The preparation for such teaching is not easy, but I have long since given up the impossible task of devising some method of teaching botany, or anything else, that can be used by teachers who know nothing of the subject. The teacher who knows nothing of his subject is necessarily a failure, and it is perfect folly to try to prop him up. There is nothing for him but to stop the farce, and either learn something to teach or seek some other employment.

It must be confessed that much of the trouble with science in the secondary schools has come, not simply from teachers who know no science, but often from the lack of pedagogical instinct that compels them to adapt their training to school and pupils. They seek to establish a minature college laboratory, a laboratory peculiarly ill-adapted to school conditions. It seems to be a hard lesson for university graduates to learn, who undertake to do secondary-school work, that a secondary school is not a college, and that it demands its own peculiar kind of teaching. Slavish repetition of college work in the secondary schools is necessarily a failure. The college supplies knowledge of the subject, and the general spirit which should pervade it, but it should never be taken as an exact model for the secondary school.

3. *Nature study.*—In the same connection I wish to speak briefly of "nature study." At first sight it may seem to have little to do with the secondary schools and colleges, but from my point of view it is a subject of vital importance to the whole scheme of education. Although formally mentioned only in connection with the lower grades, it underlies the possibility of future work, and its absence accounts for the strange inequality in numbers observed in the later years of training between those with scientific tastes and those without. Any educational scheme which for years persistently excludes any phase of work must expect a comparatively small response when it is finally offered.

Under this somewhat comprehensive title of "nature study" there has entered the schools an element of teaching so fresh and vivifying, that it has come as a revelation, and will certainly work a revolution. The average

school curriculum, fairly riveted upon us by long years of precedent, seems to be established upon the idea that education consists in the presentation of subjects totally unrelated to the experience of the pupil. This conception of education could only have been held before there was a science of education founded upon some knowledge of the mental processes of the child. Since such a science has come into existence, and has begun to accumulate its facts, we have learned the absurdities of empiricism and of speculation in education, and have turned with hope to experimental psychology. Our results are comparatively few, as yet, but they are sufficient to give us some insight into the child's mind and to recognize the warping and benumbing treatment it has been receiving. We are passing from the days of pills and potions to the days of hygiene, and are seeking not to rack the mind but to preserve its normal tone. One of the first visible mental tendencies in the child mind is the spirit of inquiry aroused by natural objects. The tendency is well known, but the natural keenness of observation in the normal child was a revelation even to those who were suspecting it. By keenness, I mean rapidity and accuracy and completeness of observation. These normal children have been passing into the schools; their attention, under compulsion, has been withdrawn from what were realities to them, to the abstractions of language and numbers; they were asked to think, but not as a result of observation; the conventional completely supplanted the real; there was thinking, but no independent thinking; the fine tentacles which were born with them finally became atrophied through disuse. When years later they are introduced to some observational science work there is a clumsiness of effort, a lack of spontaneity, an overwhelming sense of strangeness that is pitiful to see. Hundreds of such cases have I seen, and so completely has the school done its work that only here and there can a few be found whose old natural power can be in a measure restored. We have been taking a normal, healthy, powerful, God-given impulse of the human mind and have ruthlessly maimed and crippled it. The result may not be so obvious as the marring of feet practised by Chinese women, but it belongs to the same category and is infinitely more cruel. Into this condition of things nature study came, and it met the greatest need in the education of children. It is difficult work, very difficult work, and a blunderer may make a sorry showing, but so he will in anything that takes training and judgment. It meets the child on the threshold of school as the one familiar face. It satisfies and keeps active important powers to whose trained service he is entitled throughout life. It relates his school life and hence all his life to the great world of nature about him, full as it is of wisdom, of pleasure, of comfort, to those who can see. I cannot understand how we were ever so educationally blind as deliberately to eradicate nature from the lives of children and to send them out into a world robbed of half its significance.

It may be well to make a somewhat definite statement of the principles that should obtain in "nature study," and I wish to preface this by a few criticisms upon observed methods. It must be confessed in the outset that nature study as yet is largely in the hands of unprepared teachers, who have had it thrust upon them, and who are more or less conscious of their helpless-

ness. Further, quite a number of the reputed leaders in the subject are distinctly "blind leaders of the blind." As a consequence, nature study today is an ill-defined, inchoate thing, the despair of the primary teacher and the joke of the scientific fraternity. And yet, its purpose is sound, and it is bound to outgrow its youthful ailments. It is certainly a great problem, to be solved by extensive experiment rather than by preconceived notions. All statements of principles, such as I am about to make, must be regarded merely as statements of working hypotheses, until they are established or set aside through experience.

My first criticism of observed methods is directed against what I have been in the habit of calling "dead work," which means the observation of insignificant, trivial things, work that means nothing when it is done. I realize that many a teacher, through lack of knowledge, is compelled to occupy the time with anything that occurs to her, and sometimes she is honest enough to call the exercise "busy work." For example, I have seen period after period given to the study of forms of leaves, chiefly because the forms are endless, and illustrative material is easily obtained. It would seem to be a crime, except that the criminal intent is lacking, to waste a pupil's time with meaningless observations when the world is crowded full of important things waiting to be observed. Of course it demands a little knowledge on the part of the teacher to distinguish between the important and the trivial.

A second criticism of observed methods is the attempt to arouse a factitious interest in nature study by all sorts of playful and imaginative devices. Most of the books dealing with nature study cater to this tendency, and perhaps are largely responsible for it. These devices disgust strong children, just as does the foolish and forced sprightliness of many primary teachers. The whole business is as confusing and benumbing as "baby talk." But the serious point is that "nature study," imbedded as it is in conventional education, is the one chance for exact and independent observation, for cultivating the ideas that between cause and effect there can be no hiatus, that imagination is beautiful and most useful in its place but that its place is never to lead to a misconception of facts, and that there should be no playing fast and loose with truth.

It seems to me that a fundamental statement concerning nature study is that it is to keep functional what I have called the "tentacles of inquiry." It follows that a test of success is *interest*. It is evident, therefore, that no science can be presented in any completeness or in any definitely organized sequence, and hence the purpose must be *continuity of interest* and not *continuity of subject*. The resulting interest must be checked by the objects of interest, which must be important, and so I reach my general thesis that *nature study must look to a continuity of interest in important subjects.*

What are appropriate subjects? I would suggest an answer under three heads: (1) *Things of common experience.* This means that there can be no fixed schedule appropriate for every school, and it also means an adaptable teacher. The teacher who has secured a definite "outline" from some one is in danger of passing by the most important natural objects

within reach of the schools. I have seen such an "outline" prepared on the seacoast and being used by a teacher in the central west. When it came to the subject of seaweeds, a few miserable things were obtained with much difficulty from the seashore, and the glorious forest with which the school was surrounded was left without observation! This is an extreme case, but essentially the same thing is common enough. (2) *No subject should be pressed too far,* for interest may pass into disgust. Watch the pupil, not the outline! (3) *Observation should be directed more toward activity than towards form and structure.* It is fundamental in botany that plants be regarded as things alive and at work; and it is also of far greater interest to a child to watch a plant doing something than to observe form and structure, which in the very nature of things mean nothing to the observer.

What are appropriate methods? (1) Very definite work, that has already been traversed by the teacher; for it is confusing and discouraging and disastrous to work at random; some very definite result must be plainly in sight; (2) individual work in observation or experiment, which means personal responsibility; (3) unprejudiced observation, which means that the pupil is not to be told what ought to be seen; some children are so docile that they never fail to see what they are told to see; (4) bringing together and comparing individual results, a thing of fundamental importance, for it develops differences in results which must be settled by repetition, shows what is essential in the results and what amount of variation is possible, develops the habit of caution in generalization, and impresses the need and nature of adequate proof.

What are the appropriate results? (1) A sustained interest in natural objects and the phenomena of nature; (2) an independence in observation and conclusion; (3) some conception as to what an exact statement is; (4) some conception of what constitutes proof; in short, an independent, rational individual, such as the world needs today more than anything else. I feel strongly that our educational system lacks efficiency in just this direction, and that continuous training in exact observation and inference, beginning with the kindergarten, must result in more sanity among adults.

There seems to be abroad a notion that one may start with a single well-attested fact, and by some logical machinery construct an elaborate system and reach an authentic conclusion, much as the world imagined for more than a century that Cuvier could do if a single bone were furnished him. The result is bad, even though the fact may have an unclouded title. But it too often happens that great superstructures have been reared upon a fact which is claimed rather than demonstrated.

We are not called upon to construct a theory of the universe even upon every well attested fact, and the sooner this is learned the more time will be saved and the more functional will the observing powers remain. Facts are like stepping stones; so long as one can get a reasonably close series of them he can make some progress in a given direction, but when he steps beyond them he flounders. As one travels away from a fact, its significance in any conclusion becomes more and more attenuated, until presently the vanishing point is reached, like the rays of light from a candle. A fact is really only

influential in its own immediate vicinity; but the whole structure of many a system lies in the region beyond the vanishing point.

We must wonder what lies beyond, we must try our wings in an excursion now and then, but very much stress must never be laid upon the value of the results thus obtained.

Such "vain imaginings" are delightfully seductive to many people, whose life and conduct are even shaped by them. I have been amazed at the large development of this phase of emotional insanity, commonly masquerading under the name of "subtle thinking." Perhaps the name is expressive enough, if it means thinking without any material for thought. And is not this one great danger of our educational system, when special stress is laid upon training? There is danger of setting to work a mental machine without giving it suitable material upon which it may operate, and it reacts upon itself, resulting in a sort of mental chaos. An active mind turned in upon [illegible] objective material, can certainly never reach

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It may not be that nature study and laboratory science in education are the only agencies, apart from common sense, that are correcting this tendency, but they certainly teach most impressively, by object lessons which are concrete and hence easiest to grasp, that it is dangerous to stray away very far from the facts, and that the further one strays away the more dangerous it becomes, and almost inevitably leads to self-deception. It is from such a fate that people must be saved, and the time to begin is in the primary school, with nature study from which imagination and emotion are largely eliminated and the pupils are held rigidly to the facts.

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It may not be that nature study and laboratory science in education are the only agencies, apart from common sense, that are correcting this tendency, but they certainly teach most impressively, by object lessons which are concrete and hence easiest to grasp, that it is dangerous to stray away very far from the facts, and that the further one strays away the more dangerous it becomes, and almost inevitably leads to self-deception. It is from such a fate that people must be saved, and the time to begin is in the primary school, with nature study from which imagination and emotion are largely eliminated and the pupils are held rigidly to the facts.

4. *The schools and the universities.*—This problem, so far from being solved, is getting into a condition so involved that its future status is very uncertain. Questions of entrance requirements, of examination or certificate, represent the border line problems that interest schools and universities alike. As a rule, so far as the high schools are concerned, the state universities have determined these standards, and as a rule the other universities, in self defense, have followed them. From the standpoint of the university, the high school exists to prepare university students. From the standpoint of the high school, its primary function may be somewhat different. The university, and especially the state university, cannot afford to disarticulate itself from the rest of the school system; on the other hand the high school cannot afford to lose the uplift of the university. Universities, as a rule, are great storehouses of educational precedents, which have descended from mediæval times, when there were very few subjects organized for study, and these few held little or no relation to the problems of intelligent living. They were the possession and pastime of a favored few. Heredity has filled the blood of most universities with this so-called scholastic spirit, so that they find it hard to adapt themselves to the new conditions. The cut of one's education has come to be as formal as the cut of his dress coat. It should be remembered that the old selection of subjects was a matter of necessity rather than of choice; but since the opportunity for ample choice

has come, the old necessity no longer exists, although it is the tendency of most universities to regard the older subjects and the older methods as possessing a peculiar relation to education. On the other hand, the American school system is peculiarly a modern institution, developed out of the necessities of our own civilization, and seeking to meet the demands of the time. The schools are handicapped by no precedents, and have no heirloom rubbish to intercalate among their modern furniture. To the thoughtful student of education it is intensely interesting to watch the progress of the effort to articulate the very old, as represented by universities, with the very new, as represented by schools. It was necessary that it should lead to clashing opinions, and that the old and the new should mutually scoff at one another. The old had the advantage of that dignity and influence which belong to years and an honorable history; the new had the advantage of numbers and public opinion. Neither could dictate to the other, though both wanted to. It is really quite remarkable that the two have gotten along so well together, and this argues well for the deep-rooted belief of each that it must have the other. In the main, however, the universities have imposed more upon the schools than they have conceded; as is very apt to be the case when the weight of educational authority is largely upon one side. It is hard for the universities to lay aside the thought that the high schools are primarily preparatory schools. If this be conceded, then the universities must be permitted to dictate the courses of study. But it is not conceded, and still the universities have in effect dictated the courses. They have done it by making the entrance requirements so specific and so numerous that the four years of high-school are absolutely filled with them. If there is anything for a high school to do besides preparing students for college it either has no time for it or is compelled to organize a separate and independent curriculum which does not lead to college. Most schools are so situated that they cannot do both. The colleges are honest in their opinion that their entrance requirements represent the very best education for a student of that grade whether he is to enter college or not. I have helped express and enforce this opinion, and so cannot be accused of any undue prejudice if I now venture to dissent from it. I still think that a large part of the university entrance requirement represents the very wisest subjects that can enter into the curriculum of the high school; but when these requirements become so large and so specific that they destroy the educational autonomy of the high school, and convert it into a university appendage, then I am constrained to dissent. The increasing standards are to permit more advanced work in the university, and this is a magnificent purpose, to be encouraged by every true lover of education; but it must not be done at the expense of schools the great mass of whose students never enter the university. It is wise to introduce into the high school studies which may be of no special benefit to the pupil preparing for college, for they are of great benefit to the lives of those whose educational career must end with the high school. As I understand it, the high school is intended to train for better citizenship, to enlarge the opportunity for obtaining a better livelihood, to open broader views of life and its duties. In order

to be of the greatest benefit to the greatest number, its course of study must be constructed as though there were to be no further formal education for the pupil. Subjects must be related to the needs of life and of society, but this need not and should not exclude those subjects or those methods which prepare and stimulate for further study, for there should be constant recognition of the fact that the secondary school is but an intermediate stage in educational progress. I regard the recent tendency of universities to increase their demands upon the schools as unwise, and as fraught with danger. It has long been my theory that the specific demands may be very few, and these so self evident that a school would not be likely to omit them. What the universities need is not a specific kind of preparation, but a certain degree of intellectual development, a development which is usually much broader than that obtained from the average college preparation. I may be allowed to say, as the result of many years of experience, that this average college preparation presents to the universities the most narrow and unevenly trained material that can be imagined. Nowhere are the evils of specialization so apparent as in the entrance preparation demanded by most colleges. If this specialization results in comparatively poor college material, its results may be regarded as simply disastrous to the high school in its primary purpose. This is not a plea for the multiplication of studies in the high schools, for one of their great weaknesses today is their tremendously congested condition. It is a plea for the relief of this congestion by reducing the university demands, not in quantity, but in specific assignment, leaving the schools freer to exercise their own judgment in the selection of special subjects. The time has long passed when any aristocracy of subjects has any right to claim the privilege of standing guard over every avenue leading to a higher education. Any student who has successfully pursued a well-organized and coherent course for four years in a high school should be able to continue his work in the universities. There are differences of opinion as to what constitutes a well-organized and coherent course, but it could be outlined by principles rather than in detail, and the schools themselves should be responsible for its construction. A minimum of subjects and a maximum of time, continuous rather than scattered work, a range broad enough to touch upon all of the fundamental regions of work, methods that will secure precision in thought and expression, contact with the life and work of the times in which we are destined to live, are certainly principles that are sufficient, but concerning whose details none should dogmatize, for they may well vary with the teachers, and the local conditions. For instance, to require botany, when the teacher is far better equipped for zoology, is simply nonsense, an illustration which finds its parallel in every region of work. The university should always be called upon for advice as to courses and methods, but it should be from the standpoint of the schools, a standpoint best determined by the schools themselves. For instance, I would not presume to dictate to any school the way in which botany must be taught; but I would count it a privilege, upon being made acquainted with the preparation of the teacher, and the facilities at command, to suggest certain

lines of work, from which as a rational being, knowing the condition better than any one else, he could make his choice. I would regard it as my chief function to guard inexperience against waste of time and energy, rather than to specifically direct. If the teacher did not know enough to make a choice in such matters, I would advise the selection of some other means of making a living. I must confess to being a great stickler for individual independence and responsibility, and that school or that teacher which is held in the dictatorial grasp of some higher authority which permits no expression of individualism in methods, which sternly represses all spontaneity and originality, which demands an automaton-like service, is pedagogically blighted. The vast machinery of the schools which enters into every petty detail, rides them like the old man of the sea, and is converting schools into factories, and teachers into drudges.

And how shall well prepared material be recognized at the university? Lately the entrance examination system has thrust itself upon my attention afresh. I do not know whether this ghost of a dead past stalks into your educational banquets or not, but it is rampant in certain universities that rather pride themselves upon being haunted. A better scheme to show how not to do it was never devised. At the present day it is peculiar to the Chinese theory of education, and that nation should be allowed its exclusive use. It is both barbarous and unscientific. I would make no serious objection to its barbarity, if it were scientific, that is, if it obtained the information it seeks. What teacher does not recognize that the estimate of the ordinary examination must be tempered by knowledge of the daily work, or grave injustice may be done? How much greater the need of this tempering in the extraordinary entrance examination! If the tempering is necessary to obtain the facts, why not substitute the tempering entirely for the examination? Which means, of course, the substitution of the daily knowledge of the teacher for the ignorance of the university examiner. I wish no better evidence concerning the intellectual equipment of a candidate for entrance into a university than the judgment of the teachers with whom he has worked, for I can get no better, nor any other half so good.

It is strange that the universities are more concerned about their raw material than about their finished product. If they would be a little less sensitive concerning entrance requirements, and a little more particular concerning graduation requirements it might be a better expenditure of energy. It has always seemed to me that the fine-meshed sieve is set at the wrong end of the university.

In conclusion, it must be repeated that no complete change in these matters which I have presented, and in others of equal importance, can come suddenly. We can be dissatisfied with the results, and can point out defects here and there which in our judgment are responsible for them, but certainly no single opinion should be followed. The subject is too vast in its importance and in its ramifications to be grasped by any one man. Its many sides confound our best judgment. It is always easy to rail at the existing order of things in a pessimistic way, and such railing is only productive of

evil. But criticism, born of intense love for the cause of education, and longing for its best development, is always helpful. Such thoughts are at work like leaven, and when they shall have permeated sufficiently, movements will begin, quietly and moderately it is to be hoped, but persistently, and out of the movements there will slowly arise new methods, which upon trial have met with general consent. No student of our educational institutions can fail to observe that the general progress towards better things has been recently very rapid, probably as rapid as is safe for wise organization. We can afford to be optimistic at the outlook, and need only concern ourselves with recognizing and attacking the points of weakness, some of which always exist to give us occupation. There is within our educational system, not perfection, unless it be in its ultimate purpose, but a wonderful power of endless development. We are to establish an American system of education, not copied from ancient times or other countries, but drawing from them all that is appropriate, and adding our own ideals, we are to meet conditions for which we find no precedent. To such great service are you called, and it will demand not only your enthusiastic and unselfish devotion to the cause of education, but your best thought and calmest judgment as educators, and your most competent work as teachers.

OVERPRESSURE, ANCIENT AND MODERN.

W. H. PAYNE.

In the Capitoline Museum in Rome there is one large hall devoted to odds and ends, the *disjecta membra* of many pieces of sculpture. Occasionally an entire piece has escaped the graver accidents of time and has come down to us nearly intact. There is such a piece crowded close to one of the walls of the hall, and made almost inaccessible by statues of indifferent merit standing before it.* It is a funereal monument that would naturally appeal to a schoolmaster's heart. It is about four feet in height, three in breadth, and two in thickness; and in the niche in front there stands the statuette of a Roman schoolboy holding a manuscript in his left hand. On the base of the monument there is a Latin inscription giving us a lamentable account of the untimely fate that befell this poor boy, Sulpicius Maximus, in his twelfth year.

The Emperor Domitian was a promoter of learning, having, among other things, called Quintilian to direct the education of his grand-nephews.

*Through the good offices of expert photographers, I secured two good views of this monument and an excellent copy of its inscriptions, Greek and Roman, in papier-maché.

Availing himself of this material, Mr. J. Raleigh Nelson wrote the interesting article entitled, "The Boy Poet, Sulpicius—A Tragedy of Roman Education," which was read at the last meeting of the Schoolmasters' Club, and published in May, 1903, in *The School Review*.

Greek learning had become fashionable in Rome, taking precedence over Latin in the discipline of the schools. In order to promote the new learning, the Emperor offered a prize for the best improvised piece of Greek verse. There were fifty-two contestants, and among them the boy Sulpicius. The occasion was one of unusual character. Success meant the approbation of the Emperor, and possibly some form of preferment. Excitement ran high. As we may suppose, emotion was tense; mind and brain were overtaxed. The boy finished his poem, but the effort cost him his life. This monument was the parents' tribute to the memory of their lost son, and the Greek verse that was the occasion of his taking off, is carefully inscribed on the sides of this commemorative marble. Had the inscription been written in our vernacular it might have stood:—

SULPICIUS MAXIMUS
Died of Greek verse
In his twelfth year
Farewell! Farewell!!

What happened in the case of this Roman student is no doubt typical of what happened in many other cases, and justifies us in saying that over-pressure was a school disease in ancient as well as in modern times, though there are reasons why this disease is more prevalent now than then.

During the years of my superintendency it not infrequently happened that complaints reached me from parents that their children were being overtaxed with work, to the great injury of both mind and body; and it was not a rare occurrence that reputable physicians entered formal protests against what they believed to be an evil of great magnitude, contending that permanent injury was likely to befall pupils from the senseless practice of cramming. Very naturally my sympathies were with the teachers as against parents and physicians, my professional loyalty seeming to require me to discount the alledged evils. Subsequent experience and a more judicial view of the facts in the case have convinced me, that, in the main, parents and physicians were right, and I and the teachers wrong.

I think it may be said with soberness and truth that in our secondary and higher institutions of learning the exactions made of students in the way of imposed tasks, virtually compel them to violate every principle of school hygiene. For example, Alexander Bain states* that there is a natural antagonism between an active brain and an active stomach, and that for this reason intellectual work should not be undertaken until two or three hours after the morning meal; but the practice of our schools makes it virtually impossible to pay heed to this primary hygienic law. In this brief paper, I am not so much concerned with the hygienic aspect of cramming as with its sinister effects on the intellectual life.

In a notable paragraph in his *Education*, entitled "Mental Strain," Mr. Spencer makes the following statement:—"It [cramming] is a mistake, also,

**Education as a Science*, pp. 12, 26

QUINTUS SULPICIUS MAXIMUS

inasmuch as it assumes that the acquisition of knowledge is everything, and forgets that a much more important matter is the organization of knowledge, for which time and spontaneous thinking are requisite. * * * * It is not the knowledge stored up as intellectual fat which is of value, but that which is turned into intellectual muscle."* Time and spontaneous thinking! Who has ever known a college student who had time for such thinking, that is, that leisurely thinking which is involved in rumination, or the analysis and assimilation of knowledge? In the learning process there are two modes of thinking which should be sharply distinguished. In one case the mind is forced to work at high tension; while in the other, it is allowed to work at low tension, following its automatic bent. The first mode is seen in what is called drill or discipline; the second in what are called culture subjects like literature or history, where the purpose is the elaboration or organization of knowledge. A drill subject like algebra loses its proper education value when taught by the discursive or low tension method, while a culture subject loses its peculiar charm and value when taught by high pressure methods. Both modes of procedure are correct in their place, but wrong when transposed. When knowledge is to be organized, that is, transformed into structure, the movement of the mind is of the automatic or spontaneous order, in which the indispensible element is time.

It seems to be quite generally assumed by teachers that the aim of school instruction should be discipline or training. I fancy such teachers have been led astray by a false etymology. How many well intended but profitless homilies have been uttered on the magic or mystic virtues of *educre!* In the first place the derivation of the term *education* from *educre* is doubtless a mistake. The proper derivatives would be *eduction* and *eductor*. The root idea in *educre* is leadership, and not *drawing out*, as alledged. The fundamental and characteristic idea in education is nurture, the proper derivation of the term being from *educare*, meaning to nurture or to foster, education being the act of nourishing, and educator one whose function is to nourish. A school is to be judged not by the few who survive the rigors of its discipline, but rather by the many who profit by its nurture. †

Sometimes the best way to make progress is to return towards an abandoned ideal. According to the Greek conception, school is a place of leisure; and according to the Roman, a place of enjoyment or of play, but in our day there is nothing farther removed from recreation and leisure than our high pressure schools.

The evil I am criticising consists in focusing the mental powers on the process of accumulation, leaving them little or no leisure for the work of

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**Education* (Bardeen), p. 286.

†"*The school must nourish the souls of its pupils*, and the only nourishment possible is ideas. There may be other tasks—there are; the soul must be exercised and trained as well as fed; but the feeding is the first and essential thing, and the richest food of all—that which best of all builds up moral fibre—is the humanistic food that comes down to us from the past in the form of fairy tale, biography, history, and literature."—F. H. Hayward, *The Secret of Herbert*, p. 71.

organization, for which, as Mr. Spencer declares, time and spontaneous thinking are requisite. The years of college life are made too largely a grazing period, in which there is but little opportunity for rumination or meditation. The question I raise is whether a milder stress should not be placed on the process of accumulation, so that, during his college course, the student may make some substantial progress in education proper. I have wondered whether some beneficent millionaire of the Carnegie type might not endow an institution which in its programmes of study would make ample provision both for the accumulation of knowledge, and for its organization or transformation into intellectual structure, or intellectual muscle, using Mr. Spencer's phrase. I can think of no educational reform of greater difficulty or of higher utility. A feature of Hubartianism which can not be esteemed too highly is the duty it places on teachers to assist pupils in assimilating the knowledge constituting the circle of thought. The doctrine of apperception finds its justification and its value in the fact that it is an assimilative process, quite distinct from the process of acquisition, though presupposing it. Mental cramming is very like the feeding process which may be observed in railway eating-rooms where travelers feel constrained by the pressure of time, to bolt their food, rather than to eat it in the leisurely way prescribed by dietetics.

The so-called enrichment of our school courses is largely responsible for the evils of cramming. Each ambitious specialist demands a place on the programme for the subject which is the especial object of his regard. Professional zeal is to be commended when hemmed in by competing subjects, but it easily passes beyond proper metes and bounds when it inspires a strong and aggressive personality. We can live on friendly terms with a man who asserts that there is nothing like leather, but we can scarcely abide one who contends that there is nothing but leather. As long as this overcrowding of programmes continues, and there are no signs of a halt appearing, there seems to be no hope of a saner educational régime.

Here is another case in which we may make substantial progress by turning backward

In his "History of Greece," Curtius makes the following remark:— "The mental culture [of the Athenians] was but plain and simple, yet it took hold of the entire man, and this all the more deeply and thoroughly because the youthful mind was not distracted by a multiplicity of subjects and could therefore more closely devote itself to the mental food and to the materials of culture offered to it." (Vol. II., p. 410.)

Mahaffy, in his *Old Greek Education*, speaks to the same effect as follows: "Neither was there in old days that multitude of special subjects, totally unconnected with each other or with a liberal education, which now infests our educational establishments, and causes the hurry after tangible results to displace the only true outcome of a higher education—that capacity to think consecutively and clearly, which is to be acquired by studying a logical and thoroughly articulated branch of knowledge for the sake of its accuracy and method." (P. 137.)

The complexity which in these later days has succeeded the old-time simplicity is temperately stated by Mr. Wilson Farrand, Head Master of the Newark Academy, in his article on "The Existing Relations Between School and College":—"It is not enough," he says, "that the child should learn to handle skillfully the tools of all learning—the three R's; his sense of form and his aesthetic nature must be developed by drawing; his hand must be trained by manual work; his musical nature must be awakened by song; he must be brought into harmony with his external environment by means of nature lessons and the study of science; his patriotic impulse must be roused by the study of American history and by flag drills; temperance must be instilled into him by lessons in physiology with special reference to the effect of alcohol on the human system; his imagination must be cultivated by means of acquaintance with Greek and Norse mythology; he should gain some knowledge of the great heroes and events of general history; through the plentiful reading of masterpieces he should acquire a love for and an appreciation of the best literature, while at the same time his mind should be stocked with choice gems of prose and poetry that will be a solace and a comfort to him throughout his later life; it will be well if by displacing a little arithmetic or geography he can gain some knowledge of the elements of Latin or of modern language; in some manner there should be roused in him a love for trees, a respect for birds, an antipathy to cigarettes, and an ambition for clean streets; and somehow, somewhere in this wild chaos, he must learn to spell! All these things, together with sewing, cooking, carpentry, principles of morality, and gymnastic exercise can easily be acquired in the grammar grades, provided only we have good teaching and proper economy of effort. Do you wonder that sometimes teachers in progressive schools confide to us that they fear their pupils are slightly bewildered? Do you wonder that pupils do not gain the habit and the power of concentrated, consecutive work?"

Rousseau declares that we no longer know how to be simple in anything. All reforms consist essentially in a return towards simplicity. How hopelessly complex our courses of study have become! How bewildering it is to think what they are likely to become if prevailing tendencies remain unchecked! We are bound to recollect that times are changed and that we are changed with them. No one in these days would dream of recommending a sheer return to the Seven Liberal Arts; but on this scanty bill of intellectual fare it was easily possible to produce what is almost an impossibility in modern times,—a liberally educated man.

The quotation from Mr. Farrand recalls a scene that occurred in the church of Santa Croce in Florence. This ancient Gothic church is rich in those art treasures of inestimable value which have made Florence "the joy of the whole earth," and each year witnesses throngs of visitors, attracted either by vain curiosity or by a sincere purpose to gain inspiration and spiritual insight through the ministrations of art in its various forms. It goes without saying that for this purpose time and meditation are necessary. As photographers would say, there must be an *exposure*, for a longer or a

shorter period of time, depending on the resources and taste of the visitor. Any attempt to grasp all would result in losing all. In order that some things may be adequately seen many other things must remain unseen.

On the occasion referred to there was an irruption into this church of Holy Cross by a party of American tourists, numbering sixty. It was a "personally conducted" party with a leader of the strenuous order who stood not on the order of his going. I seem still to hear his orders, given in strident tones:—"Come on!" "Hurry up!" "Put up your note books!" etc., etc. Then followed a sort of scurry from tomb to tomb, through aisles and chapels, till the door of exit was reached and the party disappeared to repeat the farce at some other place of note. These countrymen of mine *had done* the church of Santa Croce in just fifteen minutes by actual count. Racing through a cathedral is very like racing through an over-crowded course of study, and one is just as defensible as the other.*

But a pernicious source of undue mental strain remains to be noted,—I mean examinations which are made to involve the fate of students for good or for evil. The evil in this case is often a double one:—the severity of the examination may be inordinate, and the consequences of failure may be a blight on the student's future life. An actual case may best illustrate my meaning: In a school of collegiate grade it was the custom to subject the first-year class to a mid-year examination of such severity that half of its members failed to reach the arbitrary standard set for passing, and so were sent home under the cloud of failure. It is easy to see how by tradition this examination became to each incoming student a terror in prospect. As a matter of fact, the nervous dread of this impending crisis fell as a blight upon the lower ranks of the school, and unfitted even well qualified students for passing this dreadful ordeal with even moderate credit. Naturally enough, when the cause of this nervous disturbance had been removed, the fear of an impending evil continued to affect the school, just as the throbbing of the ocean continues after the storm has passed.

An examination on which so much is made to depend may be as fatal in its way as a Gatling gun. Through this secular abuse of power, is it any

*Two members of the Rolling Stone Club, of Medina, N. Y., have written a book telling how to "do" Europe on $4 a day. "Florence is a dream," they say. "We came for three days and staid five, and dragged ourselves away unwillingly. Yet it can be done in a day, and we saw it being done in that way more than once. The Baptistery is noted for its beautiful bronze doors. We were standing one day before the pair by Ghiberti, when a fine equipage whirled up. Two exceedingly prosperous looking Americans, with their wives, occupied the seats."

"'These are the doors,' droned the guide on the box seat, 'that Michael Angelo said were good enough for heaven.'

"'All right,' said one of the jovial tourists, looking at his watch, we'll trust his judgment. Let 'em run!"

"And as they were whisked away after just five seconds before one of the most artistic creations in Europe, we saw the man who sat with his back to the driver, nearly dislocate his neck as he twisted around to ask

"'Who'd you say said that?'

"And the Limited having passed, we resumed our leisurely enjoyment of the masterpieces."—*N. Y. Tribune.*

wonder that in too many cases, students look upon their instructors as their natural enemies whom they may properly circumvent by ruse and fraud? I am far from thinking that the case cited is a common one, but I maintain that the evil *in kind* is frightfully common. The evil consequences of such mental strain are for the most part occult, only the graver consequences coming to the surface; but if an actual inquest could be made, the showing would be a blot on our so-called higher education. It should be remembered that one of the crudest instruments in the hands of teachers is the examination. Its abuses are so common and so flagrant as almost to justify its disuse, and its shortcomings should give pause to those who employ it as a test. It does not bring to the surface the finer qualities of spirit which constitute character, such as faith, hope, charity, but ratcher the coarser qualities of mind such as memory, imitation, rote-learning, etc., etc.

A few years ago, in a certain western state, an item to this effect went the rounds of the newspapers: "This has been examination week in our University, and the results attest the high quality of work done by our Professors. In one case, out of a class numbering nearly one hundred, only sixty were passed, the remainder being either conditioned or not passed. We think this is conclusive proof that our University is rapidly coming to the front as an institution for dispensing the higher education." More correctly stated this item would run as follows: "Professor X has taught his large class in his own way, has examined it in his own way, and his work has been so well done that only sixty per cent of his students could stand the test which he applied to them."

THE LEADERSHIP OF THE FEDERAL GOVERNMENT IN PUBLIC EDUCATION.

R. H. JESSE, PRESIDENT OF THE UNIVERSITY OF MISSOURI.

Few, even among intelligent people, realize to how great an extent the general Government has led the States and the people of our country in public education. We are prone to think of this progressive state, or this enlightened man, or that seat of learning as leading our people aright, forgetting that oftentimes the general Government has whirled onward in education, states, with their leaders and their seats of learning.

In 1787 the Continental Congress, shortly before it passed out of American history, passed an Ordinance for the government of the Northwest Territory, which means for that territory which lies west of the Allegheny Mountains, east of the Mississippi River, north of the Ohio, and south of Canada. This document contained, in Article III, this remarkable sentence: "Religion, morality and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged." This policy was confined to the Northwest Territory, but it has since been extended by the general Government to all the

territory west of the Allegheny Mountains, excepting only Texas and West Virginia. This sentence, indeed, has proved to be the Magna Charta of public education in the United States. This I shall point out later. In 1789 the Continental Congress had passed away, the Constitution had been adopted, Washington had taken his seat as President and the first Congress was holding its first session. Early in the session an amendment to the Ordinance of 1787 was adopted. This amendment was intended to bring the Ordinance into harmony with the new form of government and thereby to perpetuate it. Therefore, the amendment was practically a re-enactment of the Ordinance of 1787. This amendment and re-enactment was signed by George Washington. We are glad to bring into connection with this immortal Ordinance the name of him whom we proudly call "Father of our Country." Almost immediately after the passage of the Ordinance of 1789 the general Government made with the Ohio Company a contract whereby a large territory in that commonwealth should be open to settlement, upon certain conditions. One of these conditions was that the sixteenth section in each township should be reserved for the public schools and that two entire townships, each consisting of thirty-six sections, should be reserved for the endowment of a "Seminary of Learning," which, being interpreted into the language of today, would mean, a Seminary of Higher Learning, and which became a State University. These conditions were imposed in accordance with that sentence in the Ordinance of 1787 which declares that throughout the Northwest Territory, "Schools and the means of education shall forever be encouraged." This sentence is the Magna Charta of the public school system, and in fulfillment of its provisions, these conditions were laid upon the early settlers of Ohio. The same conditions were afterwards laid upon other states formed out of the Northwest Territory, and they were, at a still later time, extended to the states carved out of the Northwest Territory, and they were, at a still later time, extended to the Louisiana Purchase and to other states otherwise acquired. Whenever a territory west of the Allegheny Mountains knocked upon the doors of Congress asking for admission to the sisterhood of states, certain conditions were imposed upon the territory by the general Government. If the territory, by popular vote, pledged itself to carry out these conditions, it was admitted to the Union, but otherwise it was not admitted. One of these conditions was that the sixteenth section of land in each township should be reserved for public schools, and another was that, in general, two townships, of thirty-six sections each, should be reserved for the endowment of a Seminary of Learning, which, in every case, was interpreted to mean a State University. In pursuance of the educational policy contained in the Ordinance of 1787, the general Government required each territory in the country west of the Allegheny Mountains to take a certain stand in behalf of public education, elementary and higher, before it should be admitted to the Union. The people of these early territories do not seem to have been generally zealous in behalf of education. They accepted the conditions imposed by the general Government because without such acceptance they could not enter the Union;

but some of them long neglected their universities so far as the conditions imposed by the general Government permitted. For nearly thirty years the Legislature of Michigan did not give to the University at Ann Arbor a single dollar, but left it to maintain itself wholly upon the proceeds of the Federal lands and upon tuition fees. In Missouri the Legislature took no steps to found the University until nearly twenty years after the state had been admitted to the Union. When the University was finally established, it was suffered to starve for twenty-seven years without the gift of a cent from the State Treasury. The first appropriation was $10,000 for the space of two years. Then came appropriations, slowly increasing, but it was not until the University was fifty-one years old that the maternal affection of the state towards its greatest institution began to be manifested in really worthy degree. It would seem that in many cases the Federal Government led, rather unwillingly, states, so far as higher learning, at least, is concerned. Texas and West Virginia are the only states west of the Allegheny Mountains that have been admitted to the Union without conditions committing them to a public school system from the elementary forms to the university. Texas was admitted in the troublous times attendant upon the Mexican War and West Virginia was torn from the old dominions amid the horrors of civil war and as a stroke of war policy. In view of these facts, who can deny the statement that from the crest of the Allegheny Mountains to the shores of the Pacific Ocean, the Federal Government has been leading the states and their people, sometimes rather against their will, into wise policies in public education.

No account of education by the state, or by the United States, would be complete without some account of the work of Thomas Jefferson. His services as author of the Declaration of Independence, as statesman, diplomat, cabinet minister, and President have obscured the services which Jefferson rendered to education. In 1779, three years after he wrote the Declaration of Independence, Jefferson introduced into the House of Burgesses in Virginia a bill establishing in that commonwealth a comprehensive system of public schools. His bill provided for elementary schools, secondary schools, and at the head of all such a State University as has not yet been realized in our country. The bill attracted great attention at the time, but it should not seem strange that, amid the sorrows of the Revolutionary War, it came to naught. From 1779 until his death in 1826, Jefferson was dominated by a passion for freedom through republican institutions, and by a passion for public schools at public expense. For forty-seven years, with tongue and pen, in public and in private, he pleaded the cause of public education without rest or abatement. When we remember his exalted position, his wide acquaintance with public men, his enormous correspondence, his dominating passions, we can gather an adequate idea of how great an influence he wielded in behalf of education. His name may not be connected with any great act in behalf of schools. Indeed, his ideas of the Constitution rather prevented him from advocating education at national expense, but for nearly a half century he was the foremost advocate in all our land for state aid for public education from the elementary forms through the ideal

State University. It is impossible to exaggerate the influence which he exerted in fastening in the minds of the people of our entire country the idea that public money ought to be used liberally by the states for public education. The last years of his life were spent in a prolonged struggle to induce Virginia to adopt his plan of public education. For reasons that pass our comprehension, Virginia refused to establish elementary or high schools. It did finally establish a State University but it was only a tithe of that University of which Jefferson had fondly dreamed.

In 1858 Justin S. Morrill of Vermont introduced into the Senate of the United States a bill establishing agricultural colleges. The measure was passed by a small majority but it was vetoed by President Buchanan, who showed genius for doing unfortunate things. In 1862, amid the horrors of civil strife, Senator Morril introduced his bill again with slight modifications. Again it was passed by Congress and was signed by Abraham Lincoln. We are glad to connect this wise measure in behalf of higher education with the name of him whom we may justly call the second Father of his Country, and the Author of the Second Declaration of American Independence. The Morrill Act offered 30,000 acres of land belonging to the general Government to each state for each congressman and senator that it had at the time when the Act was passed. Certain conditions were prescribed to which each state had to conform in order to inherit the federal bounty. The Government made gifts to the state in behalf of higher public education with one hand and with the other hand led these states into a certain attitude before they became recipients of the gifts. These institutions were intended to be colleges in the true sense of the term. In standards of admission, in standards of graduation, in courses of instruction, they were to be real colleges. They were at liberty to teach anything, even including the classic languages, that was taught in other colleges, but it was provided that agriculture and the mechanic arts should have a prominent place in the curriculum. Some states were wise enough to place these colleges in their universities, but some were unwise enough to establish them on separate foundations. The colleges of agriculture that have been founded in universities are destined, I dare affirm, to far excel those that rest on separate foundations; while the State Universities that are fortunate enough to have these colleges in their midst, are destined to excel the other State Universities. The connection is full of blessing to the college and also to the University.

In 1887, just a hundred years after the passage of the great Northwest Ordinance, Congress passed an Act establishing Agricultural Experiment Stations in connection with the Colleges of Agriculture and it endowed these Stations in the sum of $15,000 annually. The original grants on which rest the State Universities west of the Allegheny Mountains were grants of land and when each territory had bound itself to comply with the conditions imposed by the general Government, the gift became irrevocable. The same was true of the land grant of 1862. But the Act of 1887 gave grants of money to be appropriated by Congress at each regular session and

the stations were placed under the supervision of certain officers at Washington. It was made the duty of these stations to make investigations into the arts and sciences connected with agriculture and to spread among the people by publications and otherwise the results of these investigations and such accumulations of useful knowledge as the stations might be able to gather. At first glance the field of investigation seems to be narrow, but, in reality, it was very wide. It includes research in Agronomy, Animal Husbandry, Dairy Husbandry, Veterinary Surgery, Horticulture, Entomology, Botany, and so much of Physics, Chemistry and Bacteriology as are involved in problems connected with the soil, with plant life and with animal life. But much more is involved in this remarkable Act than appears on the surface. Our forefathers had worked their way slowly to the idea that public money might justly be used for the education of the young, provided they were gathered together in elementary or secondary schools, or in colleges or universities.

But the Act of 1887 declares that public money may justly be used for research. This was an immense stride forward. Our forefathers came slowly to the idea that public money might justly be used for the education of the young provided that they were assembled in schools, colleges, or universities. But the Act of 1887 declares that the results of research in the Stations and the accumulations of useful knowledge pertaining to agriculture may be spread among the people broadcast at public expense and the information is to be given to men and to women and to the young, the middle aged and the old, not collected in schools, colleges, or universities, but at their homes. The knowledge is to be spread by publications, lectures, or by any other proper method. The Federal Government in this Act endowed research and also University Extension. So anxious was the Government to facilitate the spread of information among the people that the publications of these Stations are carried in the mails free of postage. Our forefathers justified the education of the young at public expense on the ground that an intelligent citizenship was necessary for the maintenance of republican institutions. They seem to have feared that an uneducated rabble might rise some day in this country as it did in France to tear to tatters the fabric of Government. Their policy was based on selfishness although the selfishness was not lacking in enlightenment. In the Act of 1887 the Government came much nearer than it had ever done to a policy of altruism in public education. "We must educate," said our fathers, "to protect our institutions." "We must educate," say the men of today, "because it is as much the function of a Government to educate its people as it is its function to rule them and to protect them." "We must educate," say the men of today, "not only because of the preciousness of our institutions but also because of the preciousness of the individual soul." While the Act of 1887 does not include this modern altruistic view as stated above, it comes far closer to it than any other Act of the Federal Government has hitherto come.

The endowment of 1887 was not irrevocable. Therefore, as often as Congress meets in regular session and passes appropriations for the Experi-

ment Stations, it thereby sets its seal to the truth of all the doctrines in the original Act, which was passed not by one Congress in a spasm of exalted virtue, but has practically been ratified by every Congress since 1887.

The states at first accepted the Federal bounty without doing anything themselves. The general Government had been leading faster than they were prepared to follow. But slowly first one and then another began to make appropriations out of state funds for their Experiment Stations until at the present time there is probably not a commonwealth in the Union that does not add out of its treasury to the amount received by its Station from the general Government. Therefore, as often as each Legislature meets it sets the seal of the State, unconsciously perhaps, to the truth of all the doctrines contained in the Act of 1887.

A Missourian may be pardoned for saying that the Act of 1887 was introduced by William H. Hatch, who for many years represented in Congress the First Congressional District of Missouri. The measure is now called unanimously "The Hatch Act."

In 1890 Senator Morrill, the father of the Colleges of Agriculture, introduced into Congress an Act increasing their appropriations in a sum of money which was to grow annually until it became $25,000 a year. This is generally known as the "Second Morrill Act." It was signed by Benjamin Harrison.

Does it seem to be an accident, or more, that all the steps forward of the Federal Government in its leadership of the States in public education were taken under the administrations of great Presidents? Is it an accident or more that none of these measures were passed under the administrations of Martin Van Buren, William Henry Harrison, James K. Polk, Millard Fillmore, Franklin Pierce, James Buchanan, Rutherford B. Hayes, and so on; but they were passed under Washington, Lincoln, Grover Cleveland, and Benjamin Harrison? And some would fain hope that yet another is to be passed under that magnificent man and hero, Theodore Roosevelt. It is a goodly fellowship of Presidents.

Harvard points with pride to her pious founder and so likewise Yale and Princeton and the Hopkins and Tulane and the University of Chicago. Some of these founders, peradventure, were not very pious but the term is still applied to them and probably justly. Pious they have been, certainly, inasmuch as they have founded institutions of learning. The State Universities west of the Alleghany Mountains can point with pride, as to a pious founder, to the Federal Government. They have been founded by their States and are proud of that fact, but they do not forget that the State was originally guided by the Government of the United States. In a certain sense they can claim as founders Washington, Jefferson, Lincoln, Cleveland, and Benjamin Harrison. These universities may lift up their heads in just pride for their lineage also has been illustrious. They beyond all universities in America ought to be nurseries of civic virtue. In their midst should burn like a vestal flame, unquenched and unquenchable, love of state and love of our common country.

PHYSICS SECTION

A SIMPLE FORM OF MACH'S WAVE APPARATUS.

PROFESSOR E. A. STRONG, MICHIGAN STATE NORMAL COLLEGE.

The simplification of the old form of Mach's Apparatus, a piece often made or imported by schools and colleges, consists in three modifications which only slightly impair the efficiency of the apparatus, while they render it cheaper and more convenient.

Instead of the usual rigid supports, the collapsible parallel bars may be mounted on ordinary laboratory standards by means of clamps. The apparatus may then be rolled up and treated like a map or chart, thus saving space,—a most valuable asset in a laboratory.

In order to release the balls in the two representations of reflected or stationary waves, electro-magnets may well replace the cumbrous lever, worked by the foot, seen in the original piece. Better still, a simple gravity release may be used.

Also the same piece that is used to pull off the longitudinal progressive wave may be used to pull off the transverse progressive wave.

The piece was exhibited and put into action.

Among the many methods employed to show wave forms, the speaker preferred some of the stroboscopic methods, as Quincke's.

THE RELATION OF MATHEMATICS TO PHYSICS IN THE HIGH SCHOOL.

DR. H. M. RANDALL, UNIVERSITY OF MICHIGAN.

At the present time a widespread interest has been aroused in mathematics, and some very radical changes in the methods of teaching it have been suggested. As the subject of physics is involved in the proposed changes, it seems but fitting that this conference, the representative body of physics teachers of this state, should undertake to do its part towards finding a solution for the problems thus called forth. I have been asked "to start the ball rolling," and feel I can do so in no better manner than by stating as briefly as possible, first, what seems to be the prevailing sentiment regarding mathematics teaching; second, the general ideas of the proposed changes. My information upon the subject has been derived largely from articles which have appeared during the last two or three years in various mathematical, scientfic, and educational publications. At the best, then, what follows can be regarded only as a summary of the ideas of the writers of

these articles, a majority of whom, it may be worth while noting, are mathematics teachers.

There is a large class of persons, including in their number engineers, physicists, and chemists, who want their mathematical knowledge to be strictly usable. It is the consensus of opinion among these men that it is not usable to a sufficient degree, and they demand that the mathematics taught them be less formal and more practical, and, moreover, there is a growing tendency to the admission that this position is a sound one, that knowledge, so taught that it can be used, must necessarily be more valuable than when taught otherwise.

Physics teachers as a class, moreover, have a grievance arising from the attitude which pupils assume to all things mathematical in physics. While physical ideas are being developed, a class may be all interest, but when the time comes to express those ideas mathematically, the situation changes. The more conscientious prepare to receive the bitter which always accompanies the sweet, the less conscientious ones, while present in body, are plainly absent in mind. This attitude is indicative of the dislike which the pupil has acquired for mathematics during his training in it, and of his belief in its uselessness. It is a severe criticism of the present method of teaching the subject. If physics teachers have anything to ask of mathematics teachers, it is that they endeavor to change this attitude of the pupil to the reception of mathematical ideas. As one can be interested in those things only which one can understand and do, the above situation seems to demand also less formal and more practical mathematics.

Now as to the general ideas of the proposed changes. Great emphasis has been placed on the value of mathematics as a means of mental discipline. So much so possibly that it has often become the end. Prof. Klein of Gottengen has called attention to the fact that another chief value is this: "To make the conviction grow that correct thought on the foundation of correct premises gives mastery over the external world. To do this, attention must be directed to the external world from the beginning." This is the key to the proposed changes. A quotation from a report "On the Teaching of High School Mathematics," read before the Mathematics Section of the Chicago and Cook County High School Teachers' Association, states the idea very plainly: "In present discussions of the possibility of improving the teaching of mathematics, the vital point seems to be that there should be, first, a concrete problem and then its expression in mathematical language, rather than first instruction in the language and then its application to the expression of problems. By problems we mean some real question in the world of senses, not an example from a book. If this is right, the equation has no right for existence till there is first a truth for it to tell. The more the truth told appears to the pupil as worth telling the better." If the pupil then has had experiences which are capable of being expressed mathematically, use them, if not, give him such experiences. As an illustration of the latter case, a spring balance, when the stretches due to various weights are noted, tells the fact that the stretch is always a certain number of times

larger than the weight, say 5, this truth may be briefly expressed by the equation $s = 5\,w$. Another balance may give $s = 8\,w$. Other balances would yield similar results, and a second important truth appears, *i. e.*, all balances have similar equations. This may be told by $s = c\,w$, a general equation, which can be applied to any balance as soon as c is experimentally determined.

Use is to be made of a pupil's intuition and experience. If his common sense tells him that a certain mathematical idea is true, to compel him to demonstrate it before his logical powers are sufficiently developed to make him feel the need of a proof, is to put him often in a state of confusion, as he can see no reason for proving something which is selfevident. On the other hand, if an experimental test of his ideas shows their correctness, he gains confidence in his judgments. So experimental proof may often be substituted for formal demonstrations, and even the conclusions reached by such demonstrations may well be tested experimentally.

If the pupil's mathematical ideas, wherever possible, are thus derived directly from his experiences, will he not regard the subject as a most practical one? Will he not naturally wonder, when he has acquired ideas by observation, if they may not be mathematically expressed? In short, will he not have that attitude to the reception of mathematical ideas which physics teachers would wish him to have?

To furnish these concrete ideas upon which the mathematical ones are to be built, there will have to be a mathematical laboratory. This laboratory, if one judges from the lists of necessary apparatus, might well be mistaken for a physical laboratory. This means that physics is regarded as the subject best suited to give the needed experience, and that mathematics and physics are to be closely correlated or possibly more. It may mean that neither mathematics nor physics, as such, is to be taught, but in their place a single subject which is the result of thoroughly amalgamating the two. That such a scheme could not possibly succeed if applied under present conditions is evident to no one more clearly than to those who are proposing it. Its present practicability is not the question, but rather, would such a training give the pupil a mathematical and physical knowledge which is usable, and would he be filled with a desire to use it? If this question is answered in the affirmative we come to a most practical question of our subject: To what extent could these ideas be put into operation at the present time? In the first place, teachers with a sufficient knowledge of both mathematics and physics for the successful correlation of the two subjects in the manner indicated are very few in number, and progress must of necessity be slow until such teachers are developed. However, if the present situation be accepted as it is, it is possible to make modest attempts in the direction indicated. Such attempts are being tried at various schools, notably at Lincoln, Neb., the Bradley Polytechnic Institute at Peoria, Ill., and at a number of schools in and about Chicago. The general plan of operation seems to be to have in the first year of high school work a course in elementary science, in which the physical laws with which the pupil comes in daily

contact are explained by aid of experiments. Upon the concrete ideas thus obtained, the algebra and geometry taught together are founded as much as possible. This work is continued during the second year with the introduction of elementary ideas of trigonometry. The results are said to be a greater thoroughness and insight into the subject of algebra and geometry. The pupil comes to the subject of physics proper in the third year with definite, usable ideas in mathematics, which include those of positive and negative quantities, ratio both direct and inverse, together with considerable skill in the manipulation of such equations as are ordinarily found in physics.

AN INDUCTION COIL INTERRUPTER FOR CURRENTS OF HIGH VOLTAGE.

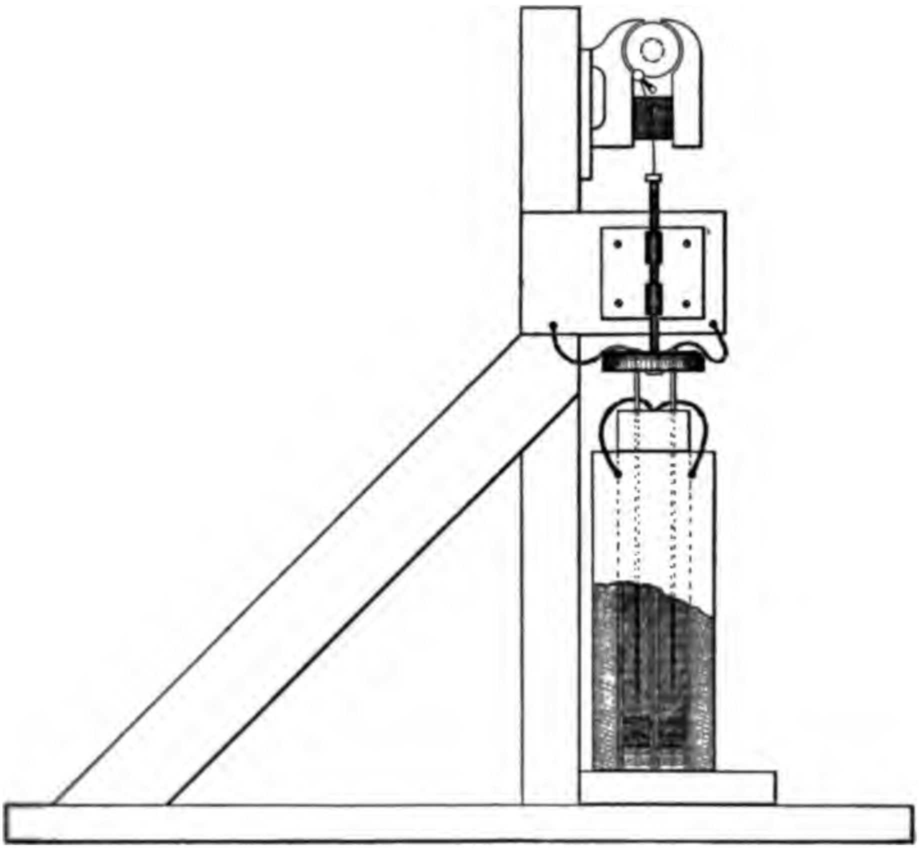
PROFESSOR G. E. MARSH, ADRIAN COLLEGE.

In induction coil work the ordinary interrupters cease to be of service if the potential difference across the break, when no current is flowing in the primary coil, is high enough to maintain an arc between the contacts, namely, about 40 volts. In the case of a coil energized with current derived from a 500 volt circuit, the drop in potential at the break is many times this voltage if the current-strength is of the requisite magnitude.

The apparatus about to be described was devised to permit the operation of an induction coil on a current accompanied by a potential beyond the range of the ordinary interrupters. The principle involved is the following: A mechanically actuated interrupter of the mercury-in-alcohol type, possessing multiple contacts or plungers, electrically connected in series, and having a large and rapid motion of translation. In detail, the interrupter consists of four glass tubes 5/8 inch in diameter and 8 inches long, placed in a square, zinc-lined box, the dimensions of which are such as to hold the tubes securely in position. The unusual length of the non-conducting liquid is to provide a column of oil or alcohol so deep that its inertia is a factor in resisting and preventing the formation of bubbles of vaporized oil at the moment of breaking the circuit, and which are essential to the existence of the arc. The lower end of each tube is closed by a cork and a layer of plaster of paris. Electrical connection is made with the stratum of mercury in each tube by means of a wire carried down through the central space between the tubes, and terminating in a flat spiral resting on the layer of plaster of paris.

Attached to the lower end of a brass rod, constrained to move vertically by means of suitable guides, is a disc of wood, and from this are supported the four plungers. In order that the plungers may be as rigid as possible, and yet free from any undue weight, they are made of copper tubing, 1/8 inch in diameter, the lower ends of which are provided with sharply-pointed copper tips. Electrical connection is made with the plungers through flexible

conducting cords. The zinc lining extends above the tubes, and kerosene oil, which is used in preference to alcohol for obvious reasons, fills not only the tubes but the space about them. The motor has a pinion on the armature shaft which meshes with a second gear on the crank shaft. The gearing is on the farther side of the motor and is not shown in the illustration. In order to simplify the mechanical construction, a piece of spring brass was



used to connect the sleeve carried on the crank with the rod supporting the plungers. This rather novel use of spring brass in lieu of the ordinary connecting rod introduces no especial resistance, and answers satisfactorily.

The breaks occur in series: that is, the mercury of tube No. 1, say, is electrically connected to plunger No. 2, and the mercury of this tube is connected to plunger No. 3, and so on. Thus there are produced simultaneously four arcs, and, in order that they may be started at the same instant, it is clearly necessary that the heighth of the mercury in each tube shall be the same, supposing, of course, that the plungers are of equal length. If one of the plungers fails to emerge from the mercury at the same instant the

others begin to leave the surfaces, the delinquency of the first increases the intensity of the arcs at each of the other three, and by prolonging the dying away of the current lessens the efficacy of the interruption. A condenser is shunted around each of the four places at which arcing takes place.

The motor alone is capable of running at a very high speed, though, with the load resulting from the weight of the moving parts, the number of interruptions is not greater than 250 or 300 per minute. The success with which the interruptions are accomplished is such that it is perfectly possible to join the coil and interrupter in series with a suitable rheostat, and obtain a satisfactory spark-length when the current is taken directly from a trolly line and has strength of 15 amperes. A shunt of comparatively high resistance connected around the coil and interrupter is, however, an addition that improves the performance of the induction coil.

By increasing the number of plungers or the rapidity of operation, or both, the fall of the current can be made as brief as required, and thus adapt the apparatus to the successful interruption of currents of any voltage. In the case of four-plunger interrupter such as described, and making three hundred breaks a minute, the time consumed in the dying away of the current is not greater than one-thirtieth of a second.

NEW USES OF THE MICROMETER SCREW.

PROFESSOR N. F. SMITH, OLIVET COLLEGE.

So many quantitative experiments in physics involve a measurement of length, that accurate methods of measuring this quantity have always claimed a large share of attention. For elementary students the micrometer screw is probably at once the simplest and the most accurate method available. Hence new uses of this instrument are constantly suggesting themselves. The following applications have been found useful:

1. *In the Determination of Young's Modulus by Stretching.*—A wire about four or five meters long is rigidly fastened to a solid wall by a heavy hook at one end. The free end passes over a pulley and carries the load. Near the free end an index of wood or metal is clamped to the wire and projects between the jaws of a micrometer caliper clamped in a rigid support. By this method the elongation of the wire can easily be measured with considerable precision.

2. *In Determining the Coefficient of Linear Expansion of a Metal.*—Many laboratories are supplied with a linear expansion apparatus in which a lever is used to magnify the amount of expansion. Considerable inaccuracy arises from the difficulty of measuring exactly the length of the short arm of the lever. This troublesome measurement may be avoided by

inserting between the end of the bar and the short arm of the lever a thin piece of metal whose thickness is approximately equal to the amount of expansion of the bar. The motion of the long arm of the lever can then be observed and the thickness of the metal measured with the micrometer caliper. A simple proportion then gives the expansion of the bar. The same method is of course applicable to other cases where the lever is used as a magnifying device for measuring a small distance, as in problems on the elasticity of bending, etc.

3. The third experiment to which I shall call attention is one which can be elaborated almost indefinitely according to the advancement and ability of the student. It introduces him to a most fascinating field of experiment to which but little attention is ordinarily given in a laboratory course, viz., the passage of electricity through gases. The particular experiment to be described has for its object the determination of the spark length in air at atmospheric pressure, which requires the same potential difference as a spark of constant length at various lower pressures. For this purpose a receiver, provided with an adjustable spark gap, is connected with the air pump, and the electrodes are set at a distance of two or three centimeters. One of the ordinary terminals of an induction machine is removed, and in its place is mounted a ball on the end of a micrometer screw in such a way that the distance between the two terminals can be readily measured. The terminals of the machine are then connected with the electrodes of the receiver and the air exhausted. The spark gap on the machine is then adjusted till the discharge passes with equal readiness between either pair of terminals. A pressure gauge connected with the receiver gives the degree of exhaustion. A small amount of air is admitted, increasing the pressure, and the adjustments are repeated.

Some uncertainty exists in making the settings because it is difficult to judge when the spark passes with equal readiness by either path. The condition of the electrodes and of the air between them have an important influence. After the discharge has once commenced to travel by a particular path, it appears to adhere to that path in preferance to the other even when the distance is somewhat increased. Nevertheless, by exercising care and taking the mean of several settings for each pressure, a very characteristic curve may be obtained. Since the length of spark is not proportional to the potential difference, the curve does not give directly the relation between electromotive force and pressure as might be desired.

An interesting variation of the experiment consists in keeping the spark length in air fixed at some constant value, such as half a centimeter, and varying the length of the gap in the receiver with each change of pressure until the two gaps are equivalent. A scale graduated directly on the rod of the movable electrode serves to give the spark length in the receiver. In this case the potential difference is kept constant, and we have the relation between spark length and pressure. The same method would serve to compare the dielectric strength of different gases.

THE USE OF THE WIRE MICROMETER IN MEASURING EXPANSION.

H. N. CHUTE, ANN ARBOR, MICH.

In the problem of determining the co-efficient of linear expansion, the chief difficulty encountered is that of measuring accurately the expansion of the rod or tube. The wire micrometer offers a very simple solution of this problem. Instead of a rod, use a tube, supported horizontally on two blocks fastened to a board or clamped firmly to the experimental table. These blocks are placed near the ends of the tube. The tube is held in place by a pin passing vertically through it near one end. This pin projects a few centimeters above the tube. The other end of the tube is kept in place by a staple. The tube is now free to expand in one direction. A second pin is soldered vertically to the tube and near the free end and the length of the tube is taken as the distance between the two pins. The wire micrometer is clamped over the free end of the tube so that the face of the screw can be brought against the outer face of the pin and the reading taken. The head is now given two or more turns backward, and steam passed through the tube till it is thoroughly heated. The micrometer head is then turned till contact is secured as shown by the slipping of the head, and the reading again taken. The difference of these readings gives the expansion. The temperatures are obtained in the usual way.

AN EXPERIMENT IN INTERFERENCE OF LIGHT.

PROFESSOR N. F. SMITH, OLIVET COLLEGE.

A simple interference apparatus has been suggested by Dr. Millikan, of the University of Chicago, which, so far as I am aware, has not been described publicly. Its simplicity renders it suitable to place in the hands of elementary students. Two pieces of plane parallel glass about three centimeters long are mounted in openings near the ends of two straight sticks from forty to fifty centimeters in length. The sticks are hinged together like a pair of tongs and the pieces of glass adjusted to accurate parallelism when the "tongs" are closed. The angle between the plates can be adjusted and the extent of opening measured by a micrometer screw placed near the open end of the "tongs."

When the plates are set at an exceedingly small angle and viewed by monochromatic light, interference fringes parallel to the hinge are distinctly visible.

If w is the width of one fringe, α the angle between the plates, and λ the wave-length, then evidently

$$\alpha = \frac{\frac{1}{2}\lambda}{w}.$$

If δ is the opening of the tongs, and l the distance from hinge to micrometer screw, then we also have

$$\alpha = \frac{\delta}{l}$$

$$\text{Hence } \frac{\delta}{l} = \frac{\frac{1}{2}\lambda}{w}$$

Since all these quantities except λ can be directly measured, we have a method for determining the wave length of light. The method is not one of great accuracy, but it appeals to the student strongly because of its simplicity. If it is found difficult to render the plates accurately parallel, we may make two settings giving fringes of different widths, and then determine the difference in the extent of opening.

THE SLABY ARCO SYSTEM OF WIRELESS TELEGRAPHY.

L. G. HOLBROOK, MICHIGAN AGRICULTURAL COLLEGE.

The three leading systems of wireless telegraphy in use at the present time are the Marconi system, owned by the Wireless Telegraph Company, London; the Braun system, owned by Siemens & Halske, of Berlin; and the Slaby Arco system, owned by the Allegemeine Elektricitäts-Gesellschaft, of Berlin. The principles upon which different systems are based are very much the same. The difference lies in minor points and details of more or less importance in perfecting the system, making it more effective and reliable.

The system devised by Slaby and Arco is the system adopted officially by the German government, and is used by the German navy on all their battleships, cruisers, torpedo boats, naval stations, etc. Also over a hundred stations have been set up on land at various places, making a complete system for military operations.

The apparatus consists of earthed transmitting and receiving antenna and direct coupling at the transmitting and receiving circuits. The sparking circuit is connected direct to the transmitting antenna and the earth. The exact influence of earthing has not as yet been clearly determined, but experiment has shown the desirability of earth connections. It establishes the

nodal points of the pressure oscillations and obviates the possibility of dangerous pressures for the operator.

The transmitting circuit consists of:—

1. Motor current circuit: Source of supply, switch, motor, regulating resistance.

2. Make-and-break current circuit: Source of supply, switch, primary of the inductor, turbine interrupter, Morse key. The primary condenser is in parallel with the interrupter.

3. Inductor high-tension circuit: Secondary winding of induction coil, spark gap, capacity (consisting of Leyden jars), exciting coil.

The receiving circuit consists of:—

1. Coherer current circuit: Coherer, syntonising coil, coherer element, relay windings, hammer and junction. A condenser is in parallel with the syntonising coil and the coherer.

2. Battery current circuit: When the relay armature has closed contact, the parallel coupling of the hammer electro magnet, of the Morse recorder, and of the polarizing cells is made through the battery.

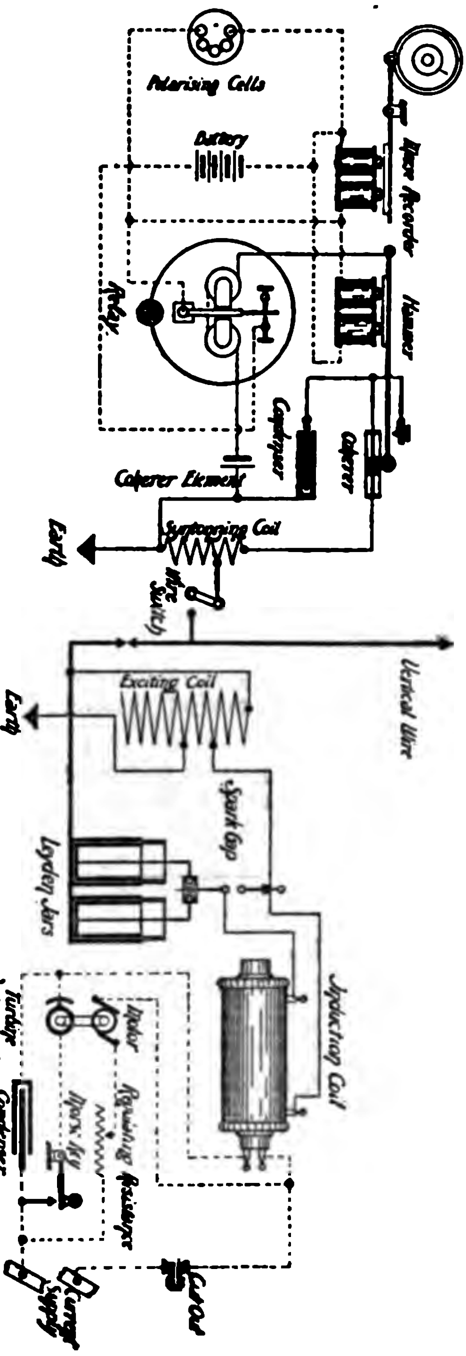
In the transmitting circuit either alternating or direct current is used for the source of supply.

For the make-and-break, the so-called turbine interrupter, designed by the German Electric Company, is found most successful. It contains a metal tube bent at right angles, the lower part dipping in mercury, and its horizontal arm covered with alcohol. The lower part of the tube is in the shape of a turbine wheel, so that when the tube is revolved by means of a small electric motor, the mercury is drawn up the tube and is discharged as a heavy jet from the horizontal arm of the tube. The mercury jet hits upon a metal ring made with a segment and placed concentric to the shaft, and thus makes and breaks the circuit. The mercury bath is connected to one main of the supply and the metal ring to the primary of the induction coil.

This type of interrupter is superior to either the hammer or mercury type of interrupter, which depend upon an electro magnet for their action. These under the most favorable conditions will not give more than forty makes-and-breaks per second. They are not adapted for rapid movement with large currents, and so can not be used for long-distance work. The turbine interrupter also has advantages over the wehnelt type. It is more continuous and more capable of standing rough usage. For ordinary work, however, the wehnelt interrupters are very desirable. They require no motor or condenser, and give from 200 to 2,000 makes-and-breaks per second.

In the receiving circuit the coherer is of special importance. The Marconi coherer is found most reliable. It consists of a glass tube in which is placed nickel and silver filings between two metal conductors about an eighth of an inch apart. The air is withdrawn from the tube, and the tube is sealed. Decoherence is made by means of a hammer electro magnet.

For anything but short distance work, a very sensitive relay is necessary. Extreme care is taken in construction to reduce friction to the least possible



RECEIVING STATION.

SENDING STATION.

minimum, and design the parts so as to attain the highest sensibility. The best relays are sensitive to the current of one ordinary dry cell acting through a resistance of 150,000 ohms.

One of the special features of the Slaby-Arco system is the tuning or syntonising of the receiving with the transmitting circuit. It is shown mathematically and confirmed by experiment that the total length of an oscillating wire correspond to half the wave-length of oscillations; each half of the wire or antenna is the fourth of a wave-length. Each wire excited by a sparking circuit has certain defined oscillations to which the electric waves it sends out into space correspond. These waves set up oscillations in the receiving antenna by induction. This receiving wire, from its size and length, is suited to a given kind of oscillation. If this be the same as that of the transmitting wire, it responds much more readily. The more complete the tuning the more complete the action. The tuning is accomplished by means of syntonising coils of wire and condensers. If the tuning is very accurate, multiple telegraphy from the same receiving antenna is possible, each system being tuned to its own transmitting circuit. Slaby was the first to give publicity to this form of multiple telegraphy. In December, 1900, he received two messages simultaneously from one common antenna. The wave-length of the first system was 640 m., distance 9.3 mi.; the second 240 m., distance 2.5 mi. A simultaneous recording of seventy-two words per minute was received.

For long-distance telegraphy Count Arco has devised a portable syntonning coil, by means of which perfect syntonism can be obtained without effecting other relations.

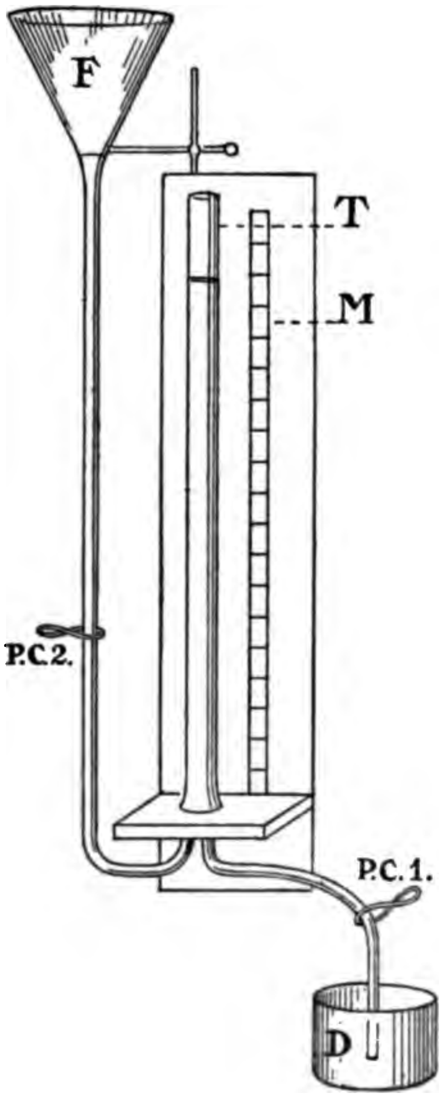
Although tuning will not prevent entirely interference by other systems, it is as yet the principal means of obtaining non-interference in wireless telegraphy.

A DEVICE FOR REGULATING LENGTH OF AIR COLUMN IN A RESONATOR.

J. E. FOX, THREE RIVERS.

The apparatus ordinarily used consists of an assemblage of parts similar to the one in the drawing, the length of air column being varied by raising or lowering the reservoir. I place the water supply stationary, above the tube (t), which is closed at bottom with a double perforated rubber stopper, through which pass two tubes of glass or brass, one of which is connected to funnel (f) with rubber tubing, the other to dish for holding water. Both tubes are closed with pinch-cocks marked p. c. in drawing.

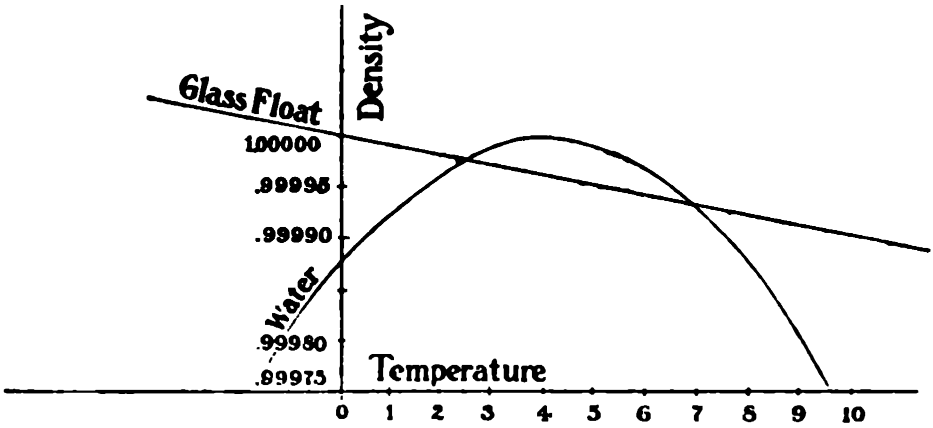
The operator sits in front of apparatus with (p. c. 2) in left hand, and (p. c. 1) in right, and eye in line with the water level. He thus has perfect control of the column through the agency of the pinch-cock. Occasionally the water may be poured from the dish to the funnel.



AN EXPERIMENT TO ILLUSTRATE THE MAXIMUM DENSITY OF WATER.

CHAS. W. BURROWS, DETROIT CENTRAL HIGH SCHOOL.

This experiment was suggested by Thos. Preston ten years ago but only recently has the suggestion been acted upon. The essential part of the experiment is a glass float so adjusted as to be but slightly heavier than water at 0° C. In this illustration today I am using three floats of slightly different densities. The curve of density and temperature tells the story of what happens.



Beginning at 0° C the glass is heavier and sinks but as the water warms the water grows heavier and pushes the float to the surface only to allow it to sink again after the point of maximum density is passed. Owing to the slight difference in density the floats do not rise at the same temperature. The following data are suggestive. The temperature is the temperature of the middle of the water:

Float	Rising		Sinking	
	Top	Bottom	Bottom	Top
Small	0	1	10	12
Medium	1 3	2 3	8 8	10
Large	3	4	6	8

If we try to get the point of maximum density from this table, we find it at about 5° C. This is the result obtained by Depretz in 1840 by means of the water thermometer. The true maximum can be obtained only by a correction due to the expansion of the glass. However, the experiment illustrates very forcibly the fact that there is a point of maximum density.

ENGLISH SECTION

THE VALUE OF LITERARY MODELS.

ROSE M. KAVANA, TEACHER OF ENGLISH IN THE JOSEPH MEDILL HIGH SCHOOL, CHICAGO.

One who undertakes to discourse on the value of literary models as a method of teaching composition has to encounter at least two varieties of objection. He finds that a considerable number of English teachers do not believe in training the student to follow models of any kind. Another class are not opposed to the use of the imitative principle, but they regard with suspicion any attempt to make the work of the high school student literary.

Addison tells us of the "condition of a good man that had one wife who took a dislike to his gray hairs and another to his black, till by their picking out what each of them had an aversion to, they left his head altogether bald and naked." When some of my listeners have picked the literary and others the imitative element out of the method for which I am to speak, my subject, too, may be altogether bald and naked.

A letter which came to me recently regarding the teaching of composition expresses these two objections in the form in which one commonly meets them. "I do not believe," says the writer, "in the use of literary models. I think the method lays so much stress on the mechanical, arbitrary side that instead of developing it would decidedly retard originality. I think it is too far from the actual life interests of the boy and girl, too advanced in literary ideal to be practical in its results. I think that it is of more value to the boys and girls and to the city and the country that they should be able to discuss potatoes, and wheat and threshing machines, and street cars and griddle cakes than it is that they be able to discuss in a superficial or even better fashion the latest or even the best in literature and art."

Let us consider first the objection that the imitative method hampers originality.

It is a commonplace of psychology that we find the imitative and creative impulses closely united in the child. He has a double personality. On the one hand he is slavish in imitating all examples set around him by his elders, and on the other hand he is self-assertive, that is, creative. Nature has joined these two powers together in the individual, in his physical, social and intellectual life. He begins his existence with but few acts of skill, and it is by imitating his elders that he acquires the further acts of skill to be found in his social environment. In the course of his effort to copy these models he finds that he consciously or unconsciously introduces novelties into his imitations. This is the beginning of invention,

for the child sees that he is not entirely dependent upon models. He learns that he can turn out interesting products containing some element at least that is his own peculiar creation. Thus our inventions grow naturally out of our imitations, as variations on the type or model. There is such a thing as imitative invention. We are too much inclined to think of imtiation as merely slavish. The divine creator and the slavish imitator are constantly set in antithesis to each other and represent only the extremes. Between these two is the normal individual, with the sense of his own agency on the one hand, and his subjection to social copy on the other. He is a creator as well as an imitator, for if one has any gift of originality, he cannot copy slavishly. It is only the weak-minded who imitate without introducing modifications. "They are slaves because they cannot be anything else. Remove their bondage to imitation," says Baldwin, "and far from becoming free they would perish." Even the genius must subject himself to this law of social absorption, if his work is to receive the permanent sanction of mankind. He can make socially effective inventions only by making new dispositions of the forms, models, activities, organizations, accumulated by race experience and acquired by him through imitation.

We are too much inclined in our abstract discussion of methods of teaching composition to overestimate the amount of originality with which the ordinary student is endowed, and therefore to put the emphasis on the individual and creative rather than on the social or imitative factor. "Console yourself, dear man and brother," says Lowell, "whatever else you may be sure of, be sure at least of this, that you are dreadfully like other people. Human nature has a much greater genius for sameness than for originality." If then in the average boy or girl the imitative is stronger than the creative impulse, and if it is possible to develop the creative through the imitative, the use of models in the proper way is the most natural and least mechanical and arbitrary of methods. At any rate no one has ever discovered a method for teaching originality directly through precepts. "The only way to be original," says Stevenson, "is to be born so." "It is a piece of good luck, the good gift of the fairy godmother brings to her prime favorites in the cradle." All we can do for an original mind is to set it in motion by some external impulse and then direct it. For both of these purposes example is better than precept, for with an inventive mind imitation becomes emulation, the model becomes a challenge, and the product turned out is not seldom better than the model. A critic says of Chaucer, "We must let him if he will eat the heart out of the literature that preceded him, as we sacrifice the mulberry leaves to the silk worm, because he knows how to convert them into something richer and more lasting."

But with all the good things that may be said of imitation we must not ignore the fact that, like all other things, it may be carried to an extreme, by being made so narrow that no room is left for individuality. There must be a compromise between the two principles. Imitation carried beyond the normal will obscure the light of genius. An invention, on the other hand, that shows mere personal capriciousness and rejects the social restraint

which comes through familiarity with literature, that is, an invention not rooted in tradition, may be a thing of great ingenuity, but is not of social value and will ultimately be rejected and forgotten by society. Creations that contain no traditional elements are likely to be mere freaks. A socially effective invention includes not only the personal but the social factor. "Of abstract originality," says Lowell, "we will not speak till authors are raised by some Deucalion and Pyrrha process; and even then our faith would be small, for writers who have no past are pretty sure of having no future." The average high school class is not, however, composed of literary geniuses, so that the problem of curbing erratic invention is not an embarrassing one with us. With the average person imitation is needed not as a check on individuality but rather as an aid to it, for the child who does not imitate does not grow.

It will be readily seen by those familiar with the psychology of imitation, as set forth in the work of Baldwin and others, that I have thus far in this paper merely applied their views to the restricted field of the teaching of composition.

Let us now consider the other class of objectors, those who think we should not aim to make the high school student literary in his writing. They are not averse to the unconscious imitation of literature which comes from the reading and study of the English classics, for every one admits that the boy who reads much will express himself more fluently and correctly than one who does not. He grows because he unconsciously assimilates literary copy above him, transcends the forms of usage in his own social circle and the commonplace thought of every-day life. The random reading of Scott, Johnson, Goldsmith, Shelley, Emerson and a host of others who "added the stolen sweets of truancy to that of study," did more for their literary development than all the formal rhetoric they ever studied.

It is not about this unconscious absorption of literature that people differ, but about the set, conscious following of literary models. We find in reading the biographies of authors that when the time came for them to think seriously about writing as a profession, many of them turned from their habit of desultory reading to the conscious and avowed imitation of literary masters whom they acknowledge as having moulded their style and thought. This is the step some teachers think should not be taken by the high school, or even the college, student. The method of the science class, namely, experiment, observation and inference, is that of the professional scientist. The method of the drawing class is that of the professional artist, but if in the English class we talk about the methods used by writers in learning their craft we are very often thought to be impractical. There is a timidity about this matter that we do not find in the teaching of other subjects. Some of this prejudice against literary methods is due to a belief in the old dictum, *Poeta nascitur non fit*, more of it to the variety of meanings given to the term, the imitation of literature. We shall need to bring these various meanings before us in discussing the objections to a literary method in teaching composition.

To some the following of models means merely imitating the *style* of various authors. The objection to a system of composition based exclusively on the imitation of style is in my opinion well founded. Individual peculiarities of expression are subtleties beyond the analytical and imitative powers of immature students, especially of those of foreign birth. This kind of imitation is too minute and scrupulous to appeal strongly to their interests, and one who looks in their work for the unique word, or the "titillation of the foaming phrase" will look in vain. These refinements belong to more matured workmanship, and may be profitably sought only by those who have mastered the structural elements of the art. Besides, the finding of something to say is quite as much of a hardship as the mode of saying it, and the mere imitation of style does not help us to discover, select or organize material. To begin with the imitation of style is to invert the natural order.

To other teachers the imitating of literature means asking the student to write on subjects which have been treated in short selections by authors. L. Cope Cornford follows this plan in his book on Composition. He gives, for instance, a selection from Stevenson, entitled, "The House I Live In," and requires the student to write a description of his own home; another selection from Mark Twain, on "Cloud Scenery," and then says, "Let the pupil take an opportunity, as occasion serves, to observe some effect of atmosphere, light and cloud; and let him make as an exact picture in words as he can." This method does not of itself build up in the pupil's mind any well-knit system of rhetorical or constructive principles. It is suggestive and stimulating but lacks pedagogical sequence and unity. It does not give us the units of literary architecture, nor does it make the work on even purely rhetorical principles consecutive.

The writer of the letter quoted at the beginning of the paper expresses a third conception of what is meant by imitating literature. He says he thinks it more important that the pupil should be able to talk and write about practical and commonplace things than that he should discuss the latest or even the best in literature and art. To discuss the latest in literature is not to follow literary models. It is merely to use pieces of literature as material for expository themes. On the other hand, one may write about even such commonplace matters as street cars and threshing machines, in a literary way. Burns's "To a Mouse" is on a commonplace subject but does not lack artistic workmanship. To write about a picture is not to paint a picture. Neither is writing about a piece of literature the same thing as writing in literary form and spirit. Moreover, the commonplace furnishes quite as good material for literature as more remote subjects, though it takes a more skillful hand to give it novelty. We cannot escape being literary by discussing steam engines, nor can we become literary by writing about Emerson. Literary quality depends upon the attitude of the writer and the form his work takes. It is not a question of material.

A fourth kind of imitation to which objection may be justly made, is the following of individual authors. In working out a general plan suited to students of different tastes and aptitudes, one would be at a loss to know

what author or group of authors to select. " 'Tis hard to find a whole age to imitate or what authors to propose for examples," says Sir Thomas Browne. We find from the study of literary history that this imitation of a master is the method most frequently used by writers in learning the technique of their art. Stevenson's testimony on this point is very often quoted: "I have played the sedulous ape to Hazlitt, to Lamb, to Wordsworth, to Sir Thomas Browne, to Defoe, to Hawthorne, to Montaigne, to Baudelaire, and to Obermann. This, like it or not, is the way to learn to write; whether I have profited or not, that is the way. It was so Keats learned, and there was never a finer temperament for literature than Keats; it was so, if we could trace it out, that all men have learned; and that is why a revival of letters is always accompanied or heralded by a cast back to earlier and fresher models. Perhaps I hear some one cry out: 'But that is not the way to be original.' It is not; nor is there a way but to be born so. Nor yet, if you are born original, is there anything in this training that shall clip the wings of your originality. There can be none more original than Montaigne, neither could any be more unlike Cicero; yet no craftsman can fail to see how much the one must have tried in his time to imitate the other. Burns is the very type of a prime force in letters; he was of all men the most imitative. Shakespeare himself, the imperial, proceeds directly from a school. It is only from a school that we can expect to have good writers."

If in our high school classes we attempted to carry out this plan and let each student choose his master, we should meet with a practical difficulty; for we should need to have as many text-books on composition as we had pupils, if they were at all varied in taste and capacity. Each book would be a guide for the imitation of a special author. If, on the other hand, we dispensed with the text-book and allowed the pupil to imitate his chosen author without direction, we should be presupposing more of the literary sense than our pupils in general are possessed of. It is only after they have learned a general plan of imitation that they can follow the individual master with profit. This method belongs, therefore, to a somewhat late stage of literary development.

A fifth kind of imitation we also find frequently in the works of authors. It consists in borrowing a hint here, a phrase there, and weaving them together in a design of the writer's own making. This may be called the mosaic method. "How pleasant it is," says Lowell, "to track poets through the gardens of their predecessors, and find out their likings by a flower snapped off here and there to garnish their own nosegays." The literary tact required to do this kind of work successfully is not to be found in the high school student. He is not able to make a unified design for his mosaic material or to put himself into what he borrows.

All of these five methods enumerated are valuable at some point in the development of a writer, but they are severally too narrow in scope, and not capable of sufficient organization, in laying a foundation in the secondary school for either literary production or appreciation.

We have thus far shown, first, that imitation is the basic principle in

the growth of expression; secondly, that socially effective creation grows out of imitation; thirdly, that when the student has assimilated and transcended the forms and thoughts of his every-day environment, as he should do, he must imitate literature if he is to grow. Contact with all kinds of authors is to expression what contact with the world is to manners. It is as true in composition as in other activities that "Home-keeping lads have ever homely wits." Fourthly, we have also shown that certain kinds of literary imitation are too one-sided or too advanced to serve our purpose as a general basis for the teaching ot composition.

It remains to set forth in the brief time remaining a kind of literary imitation that may be made definite without being narrow, that directs without being mechanical, and that looks at literature not from the purely rhetorical but from the psychological and distinctly literary side, in such a way as to reveal to the student through literature the natural workings of his own mind.

To do this it will be helpful to use an analogy drawn from mathematics. Our arithmetical notation consists of the characters 0 to 9. These are variously combined to express all other numbers this side of infinity. The first step in learning arithmetic is to recognize the ten primary numbers, the next is to combine them so as to make them express the larger values. In like manner, in the study of composition we must begin by learning to recognize a number of literary units, not arbitrarily invented, but discovered in our own natural and universal mental processes, and illustrated in literature.

In narration, for instance, we find four species based upon the spontaneous movement of the mind in contemplating a series of events. We can think and tell of a series of happenings in the past—this is retrospective narrative; in the future, which is anticipatory narrative. We can follow two series of events happening in different places at the same time. This is simultaneous narrative. The fourth is forward-moving narrative, in which we start at a given point and follow events forward step by step.

In description, are found the units of place, personal appearance, character, mode of life, mood, etc. Exposition, Argumentation and Persuasion may be similarly analyzed, and illustrations of the units drawn from literature.

The next step is to find combinations of these units in the works of authors, for the combinations found in ordinary conversation are too often determined by the accidental and extraneous, and have, therefore, too little design for more formal purposes. After some familiarity with pieces of literature built up out of these units, the student should, however, be able to make effective combinations for himself. It will be seen that this method is based on literary analysis and synthesis rather than on the mere imitation of the externals of literature. The purpose is to put the pupil in possession of the working units of composition and gradually to free him from bondage to his model as he develops the power to make his own combinations.

In the development of this system of units and their combinations, unity

can be secured by making narration the fundamental form. The first themes written should be purely narrative, the next should combine narration and description, the next narration, description, and exposition, and so on.

In composition the structural and decorative aspects should be kept as distinct as in architecture. The tendency in the past has been to over-emphasize the finish of a piece of work and to ignore some of the real problems of its organization. I do not wish to be understood as undervaluing nicety of workmanship in the use of the word, the sentence, figures of speech and the various other rhetorical matters. I am merely urging that the scope of composition be so enlarged that the pupil should be trained to handle literary as well as rhetorical units. We have been too much occupied with rhetoric, and yet innovations in the teaching of composition, like innovations in literary production, must not break completely with the past. The traditional work of the rhetorics on the units of expression and the requisites of style is all valuable. We need to conserve the best that has been done in this field with such modifications in treatment and such change in emphasis as may be necessary. This is our rhetorical heritage, but we can advance in the teaching of composition only when we recognize and add to it our heritage in literary methods. We must analyze the inventions in form and matter which we call literature, and with which the race has enriched itself, to find out the laws by which interest is held and attention economized.

PRESCRIBED AND VOLUNTARY READING OF THE ENGLISH CLASSICS BY PUPILS IN THE SECONDARY SCHOOLS.

LAWRENCE CAMERON HULL, HEAD MASTER OF THE MICHIGAN MILITARY ACADEMY, ORCHARD LAKE, MICH.

The title of my contribution is misleading because of its scope. I really wish to ask one or two questions concerning the method of teaching the prescribed selections from the English classics and to stimulate an inquiry into the results actually accomplished.

We shall all agree that English is taught more conscientiously, more earnestly, more systematically, more effectively, than ever before. But the best teachers of English are most willing to admit that they are still experimenting.

Two questions have forced themselves upon me whenever I have considered the work of an individual teacher of English or the outcome of our English teaching in general. First, does the reading of the prescribed selections from a certain author stimulate the appetite for reading more of his work; and, second, what effort is conscientiously made by the teacher to influence the pupil's style of English speech and composition by the loving study of the style of the masterpiece?

I am not in a position to speak intelligently about the first matter. Are any of us prepared to do this in such a way as to justify a hearing? If not, ought we not to consider the question seriously? If the pupil's study of the best English masterpieces creates no passion for more reading of the same kind, if he finds relief from the tedium of an unwelcome daily task by reading cheap and worthless literature, we ought to know the fact. If he developes the dangerous habit of omnivorous and haphazard reading, that fact ought to be known and to have weight in the adoption of practical methods in the class-room. We can not boast of the results of our teaching until we can show that our pupils are learning to despise and shun the latest ephemeral novel, to cease gorging upon the heterogeneous mixture presented by our newspapers and magazines, to reject that which is simply fashionable, and to hold fast to that which has been proved to be eternally good. If the reading of the prescribed classics does not lead to the habit of voluntary reading of the same kind of literature, then we or our methods are at fault. How many of us set such an example in this important matter that our pupils will be able to imitate us safely? We can not create a passion for the reading of Scott if we do not read within a year any other novel than the one set for the pupil's study. What ought to be to him a source of joy will be only a task because it is clearly such to the teacher. If the teacher of English is only a prosaic, unimaginative Gradgrind, he will kindle poetic fire only in the hearts of children who reluct and revolt against him and discreetly admire the things that they know he dislikes. But there are few teachers who deliberately condemn the author whose works they teach. Most of us see clearly that an affectation of contempt for a classic in self-condemnation. We ought all to see that the surest way in which to create an appetite for the best reading in our pupils is to cultivate such an appetite ourselves and to win them by the contagion of our own enthusiasm.

Let me consider briefly the second question. What efforts are we making to influence vitally the style of our pupil's speech and composition by a thorough, conscientious, and sympathetic study of the style of an author whose works we are reading? I do not refer to a critical hunt for misplaced commas, grammatical solecisms, incongruous metaphors, or any other violations of rules laid down in our grammars or rhetorics. People who echo the cheap criticisms of the literary style of Macaulay, or Ruskin, or De-Quincey only air their own foolish vanity. Let us take it for granted that the pupil who approaches one of these masterpieces, whether of prose or of poetry, has a sound training in English grammar and that throughout his secondary school course he is receiving regular instruction in what has commonly been called rhetoric. But let us also assume the reliability of the judgment shown by the generations that have deemed a literary masterpiece worthy of immortality. The vocabulary of English speech grows constantly. Words and phrases acquire new meanings and lose old ones. But it is safe to say that any man who lovingly studies and deliberately imitates Shakespeare, Milton, Dryden, Addison, Byron, Macaulay, Carlyle,

Lowell, or the King James's Version of the English Bible will develop an effective English style just as certainly as Franklin or Ruskin did by conscious or unconscious imitation. May we not say that the end of all the English work of our pupils, the finest flower of all our English training is the acquisition of an effective style? Of course it is true that in a sense the style is the man or woman. It is also true that if one has things to say and is properly trained he can say these things in such a way as to command a hearing. But we are not "trustees of civilization" if we teach our pupils that a crude and raw expression is consistent with noble and worthy thought. The best thought is impossible without worthy expression.

I fear that the colleges have led the schools somewhat astray in this important matter. The amount of reading prescribed for careful study is not small. The questions set for examination for admission to the colleges show that the examiners are concerned almost entirely with matters of interpretation. The questions deal with history, mythology, psychology, and dramatic criticism; but hardly a question is ever asked that concerns itself with the effectiveness of the author's style, and in marking the candidate's paper the weary examiner is compelled to use the blue pencil solely upon misspelled words, misplaced marks of punctuation, and grammatical errors.

The teacher in the secondary school judges of the college ideal by the character of the examination. This influence is felt only indirectly in this favored region where entrance by certificate has so largely banished the older method of college admission. But the indirect influence of the older system is still great even in schools that send graduates only to our state university or to other institutions that have been converted to the more excellent way. College entrance examination boards have a more vital influence upon the English teaching in our schools than any other agency. Yet in twenty sets of college entrance examination papers recently examined by me, including those of Harvard, Yale, Princeton, Williams, Amherst, Mount Holyoke, Bryn Mawr, Wellesley, Pennsylvania, Michigan, Chicago, Wisconsin, Illinois, Minnesota, Leland Stanford and the College Entrance Examination Board, which speaks for most of the collegiate institutions along the Atlantic seaboard, I have found hardly a question directed toward the discovery or the appreciation of a single beauty of style. Of course it is true that thought precedes expression. I am not pleading for the ignoring of the author's thought for the purpose of emphasizing the need of attention to the form of expression. No masterpiece is worthy of immortality that is not ennobled by the dignity and strength of its thought. But the really great authors have been able to vivify the trivial and the commonplace by the vigor and charm and simplicity of their own style. Can we read The Cotter's Saturday Night, The Deserted Village, Evangeline, or The Vicar of Wakefield without learning this lesson? Of course we all know this. But how many of us make it a part of our daily life? How many professional teachers of English linger lovingly over the beauties of a classical author and try to communicate the contagion of their own joy

to their pupils? How many pupils begin to show a dawning appreciation of style while in the secondary school? How many college students can confess to an appetite for a delicately phrased sentence or a well-rounded paragraph?

It is true with this matter, as it is with that spiritual process known as conversion, that the normal and healthy boy or girl can not locate the exact moment when this sense of joy in the use of words first became consciously recognized. Yet most of us can tell who first stimulated the quick development of the sense. The enthusiasm of some one who loved literature for its own sake, father, mother, teacher, or trusted friend, this is the provoking cause of this wonderful pleasure. And so I am not pleading for methods. Let me rather state my sincere conviction (here as in the other matter) that in the teaching of English the personality of the teacher counts for more than in any other work of our schools. Pupils will not develop a passion for the best reading if the teacher is pleased with commonplace and trivial stuff; pupils will not reverence and love the literary style of a master till they have seen the fires of reverential love blaze upon some altar reared by genuine enthusiasm.

HISTORY SECTION

THE TEACHING OF CIVICS IN THE HIGH SCHOOL.

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We are told that during the Age of Pericles every Athenian citizen was qualified to hold civil office and ably to direct the policies of state. Certainly this cannot be said of American citizenship at the dawning of the twentieth century. Furthermore, a condition exists that suggests the ravages of a fatal disease rapidly working its way to the very vitals of the body politic. It is not necessary to describe here a situation that is so well known to us all. There is enough of political ill in our land today to demand, upon the part of those who are intrusted with the education of the youth, most careful consideration. There is a demand for a better understanding of our political institutions,—their history, their purpose, and their actual working. Amid all the political isms of the day some intelligence should direct the rising generation. With the dangers so evidently before us, some guiding hand should point the way. And when we look behind the screen of laws and constitutions, and behold the trusts and politicians building up a system of bribery that bids fair to become an American institution itself, and realize that in public life the "highway of corruption is the road to success," then, we appreciate the need of a higher moral standard of living,—a more righteous citizenship.

Many men look back upon the history of our country and are proud of her glorious achievements, their hearts respond with swelling pride as they recall the names of her great men, and when her honor is attacked stand ready to die in her behalf. Yet, how many can be found who, knowing of the enemies within her borders that are undermining her very foundations and bringing shame upon her flag, are willing to sacrifice even a small part of their time for her sake? As Josiah Strong has put it, "we are in need of a new patriotism,—one that prompts men, not to die for their country but to live for it, which is as much more heroic as it is difficult." Wherein lies the salvation of our country if it cannot look to its public schools to teach the kind of patriotism that is most needed? It may not be possible for us in our day, to reach the civic perfection of the Age of Pericles, yet our system of education is at fault if it does not strive, so far as it may, toward that much to be desired goal. We are attempting this very thing in all that we teach, but is it not possible through a proper teaching of Civics, to do even more than has yet been accomplished?

The high school holds a unique place in relation to this subject. Comparatively few students who attend college will give attention to it, and little can be done in the lower grades beyond gaining a familiarity with the nomenclature of political science. In the high school we reach the largest number of pupils who have attained an age of experience and appreciation sufficient to take up the subject in a practical manner. It is here that we may expect the largest results. The public high school is supported by the taxpayers, and is in duty bound to make the best possible return for the investment made. The public certainly has the right to expect an annual installment of intelligent, conscientious citizens, fully realizing their obligation to the community in which they live.

Practically all authorities have accepted the demand for a course in Civics in the high school, and by almost universal consent it forms a unit with American history, and is offered in the twelfth grade. A few schools are still giving this subject below the twelfth grade, but are rapidly coming to realize that it can, under the circumstances, be little more than a review of the manual of government, and that the time might better be spent upon some other subject.

Before we can attempt to solve the problem before us, we must consider the varied conditions with which we are surrounded. While the course of study may be uniform, there may be a great difference in the work actually done. The number of pupils in the class, the number of teachers necessary to conduct the work, the location of the school, and the library equipment are all important factors in the character of the work attempted. The student himself must also be taken into account. What are his home influences? What advantages of progressive historical study has he had? What has been his training and experience in the use of a working library? But the most important element is the teacher. Is he specially prepared to teach the subject? Is he also the teacher of American history? Has he several other subjects to handle at the same time and in no way related to Civics?

Is he himself enthusiastic and the kind of citizen that he would make of his pupils? We may classify these conditions approximately by the general terms,—the small school and the large school. The small school presents to us a few students, probably one class in the subject and a small number of works in the library. The student has had little opportunity to develop historical methods of study and he may or may not have become familiar with the forerunners of our political institutions. In all probability the teacher has not specialized in the subject and is called upon to teach several others at the same time. On the other hand, in our largest schools we may find enough students taking the course to demand the entire time of one teacher or at least the teacher of American history, who may have specialized in his subject and can give his whole energy to his work. The school is equipped with a large and choice working library. The student has followed the work in history through the Ancient and European units, and in the work in English history has studied the origin and development of those principles of government and those very political institutions that are our own today. He may have taken a special course in the use of a library until he is prepared to do intensive work and to do it well. These two extremes and probably all intermediate stages are to be found within our state. This makes it impossible to lay down a rule by which all may be guided. Each teacher must meet the conditions bravely, and, with an ideal before him, strive to make the best of them.

The problem that first presents itself to the teacher is how to cover the ground of both American history and Civics in one year, and at the same time to accomplish the purpose and intent of each subject. The student in most instances is prepared to do an advanced grade of work, and the opportunity should not be denied him. Two general plans may be adopted, —a single course combining the two subjects and two separate courses. To combine the two subjects would mean that one would become an adjunct or side issue of the other. The chief difficulty seems to be to find a satisfactory point at which to take up the very important division of local government and municipalities. Objections to the plan are that the continuity and logical development of one or both subjects may be sacrificed, the attention of the student is more or less scattered and little opportunity is offered for intensive methods of study. However, this may be the only feasible policy to pursue for many schools, its success depending almost entirely upon the teacher. To conduct the courses separately is ideal and yet it also has its drawbacks. Then the question arises, how can the ground of either course be covered in one semester? The experience of many is that with the ordinary text-book in American history, beginning with the Age of Discovery, and with methods adapted to the ability of the twelfth grade student, the term will close with the class just beginning the period of the Civil War. The study of American history in this day and for this generation should not stop here. Also, if the course in Civics is studied from the historical standpoint, the student is covering again the Colonial and Revolutionary periods. This is an unnecessary repetition within a year. If five recitations per week are given, three

may be taken by American history and two by Civics. One plan which has been tried with success when four recitations per week are given is as follows: The so-called Colonial Period of American history is taught as a part of English history in the eleventh grade. This is, from the historical point of view, the logical way to treat the English Colonies in America up to the time of their independence, and it certainly gives the student a more truthful view of the history. Then in the twelfth grade the course in American history begins naturally with the constitutional period and reaches satisfactorily the present administration. The course in Civics follows as a history of American political institutions. In this way a thorough review of the Colonial and Revolutionary periods is given as the following topics will show: The New England Township, the Southern County and Parish, The Hundred of Maryland and Delaware, The Mixed Type of the Middle Colonies, Steps Toward Independence, Colonial Central Government, Transition from Colony to State, Steps Toward Union, The American Congress, The Federal Convention, etc. The work of the preceding year and a half is here welded into a whole and applied to the present. This scheme may not appeal to all, but we must consider that what will work successfully in one school may not be at all adapted to another. Once more each of us must meet the conditions with which he finds himself surrounded, and work out his own solution of the problem.

Another question worthy of consideration is in regard to the relative proportion of time to be given to the main divisions of the subject. Most of our text-books give the larger space to National institutions and comparatively little attention is paid to local government and municipalities in particular. We do not expect many of our students to become statesmen or to deal to any great extent with national institutions, but we do expect all of them to become citizens of some city or locality in need of loyal men and women. There is no longer any danger of lessening fidelity to the nation by putting emphasis upon state and city patriotism. If we believe that "in the vitality and strength of our local institutions lies the political stability of our country," can we not best serve the interests of our whole political organization by giving more of our time to a study of the conditions and actual working of the government immediately round about us?

It has been agreed that the relation between history and civics is very close, yet it may be necessary to emphasize the fact that the historical development of our institutions should not be slighted. The student should realize that they are a growth, organic in nature, that they have their roots extending deep down into the past, and are not to be ruthlessly hewn down. He should appreciate the character of that growth, the putting forth of new branches to meet the demands of a progressive civilization, and the process by which the unwritten constitution becomes a visible part of the complex system. He should know the value of public sentiment and should not be led to place too much confidence in the written law or even the constitution itself. As Professor Bourne has said, "it would be truer to teach that we started with a written constitution which shifting political conditions speedily

began to reshape." Thus the saying that "it is the duty of every generation to gather up its inheritance from the past, and thus to serve the present and prepare better things for the future," is particularly applicable to the study of Civics. A better name for the course might be "A History of American Political Institutions."

When taught as a course in history we may claim for Civics practically all of the educational values of that subject. It develops the imagination, the love of truth, and the power of historical thinking and reasoning.. It trains the student, not only in the use of books, but also in original investigation and personal observation of political phenomena. It arouses an active interest in the life of the community in which he lives. And added to these historical values is the intensely practical aim of the subject,—a means of fitting the pupils for the performance of the duties of citizenship and of cultivating in them an enlightened patriotism,—the "new patriotism" so much needed today. As Lincoln Steffens has just said of the great business men of our country, "they simply do not know what patriotism is. They know what treason is in war; it is going over to the enemy, like Benedict Arnold, and fighting in the open against your country. In peace and in secret to seize, not forts, but cities and states, and destroy, not buildings and men, but the fundamental institutions of your country and the saving character of American manhood—that is not treason. That is politics, and politics is business, and business, you know, is business." What a comment upon the existing standard of public morals! The ethical value of Civics when properly taught, cannot be denied. Here the student recognizes his own relations to society. He is made to understand the obligations that rest upon him as a member of a community, and this knowledge tends to arouse in him a higher standard of moral action. The truth of this may in part be seen in the efforts of our young college men who are today exerting a most wholesome influence in public life. This is not intended for the boys alone but just as much for the girls. This is well illustrated by the yell given by the girls of a co-educational institution before whom Mr. Folk of Missouri appeared to give an address:—

> "Joe Folk! Joe Folk!
> He's the man.
> If we can't vote
> Our sweethearts can."

We may fit both boys and girls only indirectly for citizenship, but we may through them lay the foundations for a sound public sentiment, and this after all is the great hope of our political salvation.

The method of teaching Civics, like other problems, depends upon conditions. In general a text-book, when a good one can be found is in the high school a very desirable help. Several books of merit have recently appeared and more are promised. The difficulty with the ordinary text-book in Civics is that it is written for general sale and is strong only on the national government. The very nature of the subject makes the text-book of minor importance. Our state and local institutions are widely varied and

are constantly changing. Even the national government is gradually expanding its powers, so that we soon realize that the subject is a progressive one and that text-books can hardly keep up the pace. We must teach more than any general text-book can well contain because it is the actual government rather than the theory that we are after. It is pedagogically wrong to teach the youth the theory of government and then send them out into the world to find that the practice is something quite different. The text must be supplemented in various ways in order to put the necessary data into the hands of the students. A choice collection of national public documents may be had for the asking. The state manual with its constitutions, historical sketches, records, maps, reports, pictures, duties of officers, departments, and institutions is a most valuable book. For local government the compiled laws, reports of officers, blank forms used in public business, municipal and department manuals, and the newspapers afford all that can be desired and practically without cost. The student, provided with this source material should, with a fair reference library, be expected to accomplish very satisfactory results.

In regard to the practical value of Civics, we have an opportunity, as in almost no other subject, to bring the student into direct contact with the actual demands of his future life. One of the most valuable aids to the course is a well planned and executed system of student reports. Most of our high schools are located in cities and possibly county seats. If so the student has a perfectly equipped laboratory in which he may work out by original investigation, the theories and principles which he has studied. The character of these reports will be recognized by the following suggestions: A brief report of the actual working of some public office obtained from the laws, the reports, and a personal visit to the office; A report on the method of transacting some actual public business with the blank forms used properly filled out; A report on the passage and execution of some particular law or ordinance with personal observations as to its proper execution, and if not properly executed an opinion as to where the responsibility should be placed; A brief or formal argument for or against some change in the existing forms of government as suggested by the various reform movements. If the student is prepared for the work, longer reports or theses form a very valuable source of training. The subjects should be chosen at the beginning of the semester, work upon them should be continuous, and liberal credit should be given for the result obtained. This work should be original in character and historical, if the source material be obtainable. A few such topics follow: An account of a spring or fall election; The process of taxation in the city or the county; A history of some office or department; Some event in local history; A criminal or civil process at law, etc. Another good scheme is a newspaper clipping note book, in which are kept all clippings bearing upon the work, with comments upon their application to the theory and practice of government. And in this respect the newspapers, which are our public watch dogs, exercise a very wholesome influence. The field is almost unlimited and every teacher who is thoroughly

alive to the possibilities of the subject will find in these reports an inspiration, and will find the students eager and enthusiastic in their work.

In conclusion then we should recognize the need of our country and the opportunity of the high school to serve its best interests. We should strive to improve the existing conditions, the equipment of the school and the preparation of both student and teacher. We should keep before us the responsibility and noble purpose of our work, and with high ideals, employ such methods as may seem best fitted to accomplish the desired results. These methods should aim to bring the student into contact with the actual working of the government in order to emphasize the practical and ethical values of the subject. It should be taught as a separate course wherever it is possible so to arrange it, and placed in the last year of the high school curriculum. It should prove to the student a means of historical review; it should give him a correct notion of the unity of all history; it should equip him with the weapons of peaceful warfare and inspire him with a desire to serve his city and his country as an independent, intelligent, conscientious citizen.

THE RELATIONS BETWEEN THE TEACHING OF HISTORY AND THE TEACHING OF GOVERNMENT IN SECONDARY SCHOOLS.

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My text will be found in one of the admirable series of lectures on political science by the late Sir John Seeley of the University of Cambridge (England):

> "History without political science has no fruit,
> Political Science without history has no root."

The subject before us is simply the elementary teaching of political science, and these statements in reference to the more advanced subject are equally true in reference to its more elementary treatment.

I shall take up the two statements in inverse order. And the first point I wish to establish is that the teaching of government, or politics, or political science--whatever it may be called--must be grounded and rooted in history. The attempt has sometimes been made to treat the two as entirely distinct, and to teach government as it exists today merely as a descriptive subject without reference to the past. To do this is to ignore one of the most fundamental facts concerning political institutions, the process of development or evolution, which is no less true of political organization than it is of animal life. Without a knowledge of the historical conditions which explain the origin of institutions and a study of their historical development, it is impossible to understand how our present system came to be, or why many of the existing institutions and laws are as they

are. Without a knowledge of history, it is impossible to realize that this process of development is still going on; and to teach simply the present is to convey an erroneous impression as to the fixity and permanence of the machinery of government. History, too, emphasizes, or should emphasize, the relation between social and industrial conditions and political institutions, and should thus make clear that as the former change the latter may also have to be altered. In all of these ways, then, history is an essential preliminary to adequate work in the treatment of civil government. As Bishop Stubbs has said: "The roots of the present lie deep in the past, and nothing in the past is dead to the man who would learn how the present comes to be."

But, more than this, many of the important topics that are connected with a knowledge of our government and political conditions can be taught in the history course, and some things can be better taught there than in a systematic treatment of present institutions. The course in English history can make clear many features of our political system, such as the safeguards of individual liberty in their development from Magna Charta to the Bill of Rights, the origin and development of judicial courts, and the growth of representative institutions. And the course in American history can explain such matters as the colonial beginnings of local government, the causes which brought about our federal system of government, the general nature of the federal system, the admission of new states, the history of parties and their leading principles; and such topics can be more fully explained in connection with the historical events of the time than in an analytical account of the governmental organization of today.

Moreover, the work in history, or at least a good part of it, should precede the systematic study of civil government in secondary schools. In the elementary schools some merely descriptive instruction in government may be taught in connection with other subjects: but for the more thorough course which secondary schools should offer there are three reasons why the history work should precede. In the first place, the narrative of events which history presents is simpler and easier to understand than an analytical exposition of a political system; and thus lends itself to the earlier stages of instruction. In the second place, the historical facts form much of the material for the analytical discussion: and it is in accordance with scientific method to collect material before attempting to classify and arrange it. To follow the opposite order involves *a priori* assumptions, and inculcates erroneous habits of thought. In the third place, if the teaching of government is to have the largest possible influence in training in the rights and duties of citizenship, it should be taught in the most advanced stage of the school work. If taught in the lower classes, some of the more difficult questions must be omitted or treated in a less satisfactory way than can be done in the upper grades of the same school.

If, then, I have demonstrated the importance of history as a basis for teaching government, it is equally important to emphasize the other part of the text,—that the study of history without some study of political institu-

tion or government is incomplete and misses one of its most important purposes. While in some places civil government has been taught without any basis in history, in others history has been taught without any special work in government, on the ground that all the essential points in the latter can be taught incidentally in connection with the history work; and this latter claim has been implied, if not openly set forth, by some whose statements are likely to carry weight. In my opinion the one view is as mistaken as the other.

The importance of systematic work in government can be shown from general considerations. To be satisfied with the work in history is to assume that the modern scientific method is entirely mistaken, or at least that it is adapted only to the physical and biological studies, and is inapplicable to social and political facts. To state this alternative seems to me sufficient. For I do not think that any one who understands the situation will deny that the same advantages of classification, comparison and analysis apply to the latter field as fully as to the former.

A more specific examination of the particular question will lead to the same conclusion. The study of political history or political institutions by any method as a part of school instruction may be urged on two grounds. In the first place, on the general basis which underlies all education,—for the purpose of securing a knowledge of our environment. In the second place, and in particular, because in a country like our own where the government is based practically on a system of manhood suffrage, and where good government depends on an intelligent and honest exercise of that suffrage, it is essential that the people should understand their rights and duties as voters and citizens and their relations to the government. And if even a small proportion of the citizens are to learn of these things in any other way than through the biased and partisan statements made in the heat of political campaigns they must be placed on the right road in the schools.

That the study of history is an essential part of this necessary training on both grounds I have already indicated. But does this alone give an adequate conception of our political environment, of the rights and duties of citizens, and of their relations to the government? To be sure that my own impression as to what is now covered by a course in history was not mistaken, I have examined some of the most recent text-books in history, and I think I am safe in saying that a course in history still fails to deal with the political environment which is nearest both in time and place, and still fails to acquaint the citizen and voter with many important facts in reference to the government and his relation thereto.

I have already indicated some of the topics connected with the study of government which can be and are considered in a course in history. But in addition to these, there are others of equal importance which are not considered in such a course. Such, for example, are the origin and justification of political societies, the fundamental principles of law and justice, state government—in particular the work of the legislatures and the courts, local government—especially in the cities, the functional activities of govern-

mental officials, the acute political problems of the present, the organization of party machinery and its influence on the working of political institutions. All of these matters are certainly of equal importance with those covered in the course in history; and they include those parts of our political system which most largely affects the daily lives of the citizens, and those which can in turn be most directly controlled by the voters at the polls.

In reference to the one subject of state government, which is entirely ignored in high school courses on history, Woodrow Wilson, now President of Princeton University, has pointed out that:

"All the civil and religious rights of our citizens depend upon state legislation; the education of the people is in the care of the states; with them rests the regulation of the suffrage; they prescribe the rules of marriage, the legal relations of husband and wife, of parent and child; they determine the powers of masters over servants and the whole law of principal and agent, which is so vital a matter in business transactions; they regulate partnership, debt and credit, and insurance; they constitute all corporations, both private and municipal, except such as fulfill the financial or other specific functions of the federal government; they control the possession, distribution, and use of property, the exercise of trades, and all contract relations; and they formulate and administer all criminal law, except only that which concerns crimes against the United States, on the high seas, or against the law of nations."

Not only are such subjects as I have mentioned omitted in the present treatment of history, but it does not seem possible to consider them adequately and to give a satisfactory idea of our present political system by any historical method. History necessarily looks towards the past and surveys a succession of events. A satisfactory treatment of government must look primarily at present conditions and describe a rather complicated mechanism of political organization. The two things are closely inter-related; and I have tried to show how the study of government requires a knowledge of history; but nevertheless the two are distinct, and each can be more easily understood and a knowledge of their mutual interplay can be more easily gained if they are studied as separate subjects.

One serious difficulty in teaching civil government incidentally in a course in history in this country is presented in the character of our government. Doubtless one reason why our text-books and courses in history fail even to mention state and local government after the Revolution, is that it would complicate and confuse the account of national history to combine with it the internal political history of forty-five different states and systems of local government,—for in spite of certain large tendencies in common there are many wide variations between the different states. While, if such a history were prepared, it would overburden the young students with information about other states, which will not directly concern them in the exercise of their political privileges. But by separating the work in government from that in history, it is possible to deal in the government course both with the national government as a systematised whole, and also with the government of the particular state of immediate concern to each particular

school; and to do this in a way that will give some definite notion of each, and of the relations of one to the other.

I shall not attempt to discuss in detail the outline of his course in Government, which Mr Davis has so well described. The essential points of his plan I can endorse, since they are in accordance with what I have said. He bases his course on a thorough foundation of history; but at the same time has recognized that the study of government must be treated somewhat apart from the narrative history, and by the analytical rather than the narrative method; and he has emphasized, what can only be emphasized by such a method, the importance of state and local government. On minor details, as to the precise division of labor between the history course and the government course, there is room for some difference of opinion; and the final conclusion on these points must rest largely on the experience of secondary school teachers.

On one other point I may add a few words,—on the importance of adequate and special training on the part of teachers for work in civil government. Until recently, it must be confessed, our colleges and universities have not offered opportunities for special training in this field; and those now teaching must equip themselves, by studying not merely school text-books on government, but also more advanced works on political science, current literature on present politics, and the constitutions, statutes and other original sources on political institutions and their working. Those still receiving their preliminary training have now larger opportunities for special training in this field than formerly. And there can be no doubt that the same advantages which result from specialized training in other branches of educational work are to be secured also in this particular subject.

MATHEMATICAL SECTION

MATHEMATICS IN THE HIGH SCHOOL COURSE*

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I enter a discussion of this feature of a High School Course with some hesitation, for I appreciate, partially at least, the many factors which must be considered in outlining such a course of study. I realize that the first requisite is a comprehensive view of the whole situation, and having obtained that, one must concentrate his attention on a specific detail of the view, without losing sight of the whole. This, I take it, must be a general attitude of the true teacher.

*This paper is a discussion of the preliminary report on a High School Course, presented by the Commission of the State Teachers' Association at the meeting in December, 1903.

Much has been said and written in recent years on the scope and purpose of secondary schools, especially public high schools. A part of this discussion has focused on the idea as to whether the course of study is to be arranged on the basis that the high school is to be the "finishing" school of the majority of those attending, or whether the school is to be considered as merely preparatory to something higher. I have no desire to reopen the discussion, and will allow the Committee of Ten to formulate my position, in which I think you will all, in the main, agree: "The Committee of Ten unanimously agree with the Conferences. Ninety-eight teachers, intimately concerned either with the actual work of American secondary schools, or with the results of that work as they appear in students who come to college, unanimously declare that every subject which is taught at all in a secondary school should be taught in the same way and to the same extent to every pupil so long as he pursues it, no matter what the probable destination of the pupil may be, or at what point his education is to cease. Thus, for all pupils who study Latin, or history, or algebra, for example, the allotment of time and the method of instruction should be the same year by year. Not that all the pupils should pursue every subject for the same number of years; but so long as they do pursue it, they should all be treated alike. It has been a very general custom in American high schools and academies to make up separate courses of study for pupils of supposed different destinations, the proportion of the several studies in the different courses being various. The principles laid down by the conferences will, if logically carried out, make a great simplification in secondary school programmes. It will lead to each subject being treated by the school in the same way by the year for all pupils, and this, whether the individual pupil be required to choose between courses which run through several years, or be allowed some choice among subjects year by year."

In making a course of study like this, I presume that, after settling what specific part the school is to take in the development of the pupils, the next step should be to determine what studies would best accomplish such development. Here, again, I have no desire to present at this time the claims of mathematics as well adapted for this or that discipline. The Committee of Fifteen on Elementary Studies place the study of mathematics side by side with language study, claiming for it a place second only in importance to that of language. The programme of every secondary school in the land furnishes evidence of the high place of importance given to mathematics. The allotment of time, I take it, is a very important matter of administrative detail, one which presents many difficulties, which requires a clear comprehension of the comparative claims of many subjects, and which must often be modified, more or less, by local conditions. With a half-year of algebra in the grades, together, I presume, with more or less experimental geometry in connection with drawing and otherwise, an allotment of fifteen year-hours for algebra and geometry is not far from a fair and equitable one.

I am not sure as to the significance of the words "course of study"; whether it means a course which should be more or less closely adhered to.

or whether it means a course which should serve as a "norm" or basis upon which to build a specific course. From conversation and correspondence with some teachers, I have inferred that the former was intended, for some have indicated their approval of the plan on the ground that, if it were generally adopted, the problem of arranging the studies of pupils moving from one city to another would be greatly simplified. If the latter idea is that of the Commission, it would be easier to discuss; for I could then substitute the word "mathematics" for algebra and geometry, and leave the distribution to the individual school. At any rate, as the distribution of algebra and geometry is to be discussed later, I shall adopt this course.

In the development of our educational system we passed through an epoch when more advanced mathematics were scarcely known in our schools, so that the course in arithmetic was expected to include all that the pupil would ever know of mathematics. With the usual conservatism of educational practices, these methods continued when the more advanced subjects were introduced. It soon became evident that there was, then, no sound reason for the retention of a considerable part of the arithmetic course, and educators charged with making model schedules of work, proposed abandoning a part of it. Foremost among those who advocated this, was the Conference on Mathematics, who reported to the Committee of Ten as follows: "The Conference recommends that the course in arithmetic be at the same time abridged and enriched; abridged by omitting entirely those subjects which perplex and exhaust the pupil without affording any really valuable mental discipline, and enriched by a greater number of exercises in simple calculations and in the solution of concrete problems." As a consequence of this, or better said, simultaneously with this, arithmetic was relegated to the grades in many schools, some persons believing that it can and ought to be finished in the first six grades, others advocating its continuance through eight grades. It may be here added that this does not include so-called "commercial" arithmetic, which is given in connection with commercial courses.

In spite of this, there seems to be a tendency to keep a distinct place for arithmetic in the high school course. In order to ascertain the sentiment of school men on this subject, Professor Lyman and I sent a circular containing this inquiry to school men of the state, mostly principals and superintendents: "Should arithmetic be taught in the high school as a part of mathematics?" The weight of the replies answers the question in the affirmative. Of the forty-one replies received to date, *five* answered decidedly *no*; *six* answered yes, as an elective, and *twenty-five* answered *yes*, without apparent qualification.

How much of this is due to natural conservatism and persistence of educational traditions, or how much to the feeling that the work is not and cannot be satisfactorily done in the grades, it is difficult to determine. I wish I were wise enough to suggest the right course. Sometimes, when I have been annoyed by having the fine point of a beautiful problem in analytic geometry misshapen and blunted by the inability or slowness of a pupil to

add or divide two common fractions, I feel like vigorously advocating arithmetic in the high school. My present feeling on the subject may be expressed somewhat as follows: If the work in arithmetic were done as might reasonably be expected in the grades, if a proper review of arithmetic were opportunely made and emphasized in connection with algebra and geometry, thus enlivening and enriching all three subjects, and if sufficient time were given to do this, then the high school course might omit a formal place for arithmetic. I have in mind a course in mathematics, while others may be thinking of courses in arithmetic, algebra, or geometry.

Most of our engineering schools, and some of the medical schools, which have not set the standard of admission as high as a bachelor's degree, require plane trigonometry for admission. Some schools are doing this work, and it appears on the surface that there should be a place where this could be inserted. It is important enough to receive consideration at the hand of the Commission.

I have been all too long coming to the specific report of the Commission. The course is built on the unit plan, five hours per week for a year in mathematics counting as a unit. It is supposed that a half-year of algebra has been done in the grades, presumably in the eighth. In the ninth grade is placed a year of algebra, five hours per week; in the tenth, a year of geometry, five hours per week; in the eleventh grade no allotment is given to mathematics, but in the twelfth grade is a half year of algebra followed by a half-year of geometry five hours per week during the year. As stated before, I shall not discuss the distribution of subjects feature of the course.

An important defect in the course centres around the gap in the eleventh grade. This appears to me an application of unsound pedagogical principles, which will necessarily impair the results. I consider that the Commission should make a strenuous attempt to remedy this defect, for a discontinuity of twenty-seven months in the study of algebra and a discontinuity of twenty-one months in the study of geometry are imperfections which need only to be mentioned to be seen.

If one turns to the Report of the Committee of the N. E. A. on College Entrance Requirements, he finds suggestions for the arrangement of the course in mathematics from the seventh to the twelfth grades, inclusive, as follows:

Seventh Grade—Concrete geometry and introductory algebra...4 periods
Eighth Grade—Introductory demonstrative geometry and algebra.4 periods
Ninth and Tenth Grades—Algebra and plane geometry.........4 periods
Eleventh Grade—Solid geometry and plane trigonometry.......4 periods
Twelfth Grade—Advanced algebra and reviews................4 periods

The course under discussion has many of the features of this suggestion. Plane trigonometry is taken out of the eleventh grade, advanced algebra out of the twelfth grade, the solid geometry of eleventh grade is pushed forward to the twelfth grade, leaving the eleventh entirely open, and one hour or period per week is added in each year of the high school course. In this

way, the required subjects are obtained, but the continuity of the other programme is destroyed.

I suppose it devolves upon me to say something in the way of suggestions of a better course, a difficult and delicate matter. I have said that I considered the allotment of time a fair one, and by that I abide. Fifteen year-hours, or if you grant an additional one for reviewing arithmetic, sixteen year-hours will serve as a basis of reckoning. The easiest way of distributing this is four hours per week throughout the four years. The administrator here says that it cannot be administered. Not on the five-hour unit basis truly, but is this the only way possible?

Professor Lyman and I also asked the question, "Should mathematics be taught continuously during the four years?" The answers to this question were about equally divided between the affirmative and the negative. Many of those answering in the affirmative included arithmetic in the course in mathematics. I inferred from explanatory remarks that a number of those answering in the negative did so under the impression that five hours per week for the entire four years was intended. I think most of us would agree with the latter under this supposition. Some Michigan schools follow at present the plan of omitting mathematics from one year of the high school, but I know that in some cases this has proved unsatisfactory. In others algebra and geometry are omitted in two semesters not consecutive arithmetic being given either as an elective or required study in one of them.

As a compromise with the five-hour unit basis, I would suggest the following:

		IX	X	XI	XII
	Grade	IX	X	XI	XII
	Hours	5	5	3	3
or		5	4	3	3

This puts two years on the five-hour basis, and two years on the half unit basis. Such a course is, and can be administered, as is evidenced by the twenty or more public high schools of Greater New York.

I believe that the Commission has undertaken a good work, and it is in appreciation of this that I have given the matter some attention. I wish their report to be a credit to the educational sentiment of Michigan. As it now stands, I feel that it contains little or nothing, as far as the course in mathematics is concerned, which will be suggestive or helpful to any high school in the state

SOME GENERALIZATIONS FROM THE ELEMENTARY GEOMETRY BY MEANS OF CENTRAL PROJECTION.

A. B. PIERCE, UNIVERSITY OF MICHIGAN.

In the study of advanced geometry, it is found that, by the introduction of certain new or more general ideas, the theorems of the plane geometry as ordinarily developed are but special cases of more general theorems. We readily understand the value of any point of view or method of treatment by which generalized theorems may be obtained, and especially if they can be obtained out of the special theorems themselves. One such method is found in the Projective Geometry. In the following paper, I propose to develop enough of this subject to make a few generalizations of some of the most elementary theorems; and also call attention to a few of the ideas which are of great importance in the modern geometry and which can be readily brought forward in this connection. We shall confine ourselves to relations between plane figures, although we shall find it necessary to make use of certain simple properties of the geometry of three dimensions.

Some of the general characteristics of the relations to be considered by us here are familiar enough to us from our common experience with shadows on the walls obtained by holding some object before a lamp or other source of light, and are readily obtained by comparing the figure held up with the resulting shadow. Of course, this is only a rough approximation, but it will give a very good idea of the character of the relations which we are to consider.

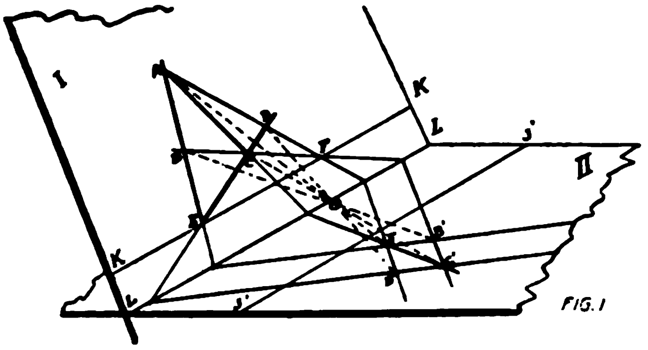


FIG. I

For the purpose of mathematical study, we reduce to ideal conditions as follows: Consider that two planes are given, one of which is called the *original plane* and the other the *plane of images*. The correspondence between the points of the two planes is such that if pairs of corresponding points be taken, the straight lines joining every such pair always passes

through a certain fixed point not in either of the planes, just as the point in the shadow and the point on the original object, in case before cited, lie on a line through the source of light. In this case the image is said to be obtained from the original object by Central Projection, and the fixed point common to all the lines joining corresponding points is called the Center of Projection. As you may readily see by examining the preceding figure.

From this it follows that only one point on the plane of images corresponds to a point on the original plane and conversely. Also if a series of points on one plane lie in a straight line, the corresponding points of the other plane also lie on a straight line, which is the intersection of the plane of images with the plane through the center of projection and the line in the original plane. Further, if a point describes a curve in the one plane, the corresponding point will describe a curve in the other; this curve is the intersection of the second plane with the conical surface generated by the straight line through the center of projection, O, and the moving point. Then, to a secant to a curve will correspond a secant to its image, and to a tangent to any curve will correspond a tangent to its image.

If we examine our figure more closely, we find that straight lines through a point project into straight lines through a point. Calling I the original plane, we notice that there seems to be an exception when the common point of intersection lies on K K, where K K is the intersection of the plane through the center of projection parallel to the plane II. In this case the lines become parallel, as is indicated in the figure, taking E as the point of intersection. A B E and D C E become A' B' and D' C' respectively. In this case we say that the point E is projected into a point of II, which is at an infinite distance. In a similar way the points of I at an infinite distance are projected into J' J'. This we can restate as follows: *All lines of I which pass through the same point on K K are projected into a set of parallel lines on II; and any set of parallel lines of I projects into a set of lines of II which intersect J' J' in the same point.* It is evident that every point of L L projects into itself.

Let us now consider the figure made up of the four points A B C D of I, and the straight lines A B, B C, C D, D A passing through them. These form a general quadrilateral. We will now prove the following property:

By a proper choice of the center of projection and image plane, any given quadrilateral can be projected into a parallelogram; and inversely any given parallelogram projects into a non-special quadrilateral, in general.

Let A B C D of plane I be the quadrilateral, and E and F the points of intersection of the opposite sides. Now choose as image plane II, one parallel to the line E F and for center of projection O, any point in the plane through E F parallel to II. We see immediately that projection of the quadrulateral is a parallelogram, and the first part of our statement is proved.

For the second part of our statement we may begin with II as the original plane. Then choosing O as entirely arbitrary, we find that at least one pair of the parallel lines project into non-parallel lines, while in general the projections of both pairs will be non-parallel.

Before turning to the generalization of theorems, we must introduce a few definitions and the fundamental property of Projective Geometry.

Definitions:

1°. If a set of points lies on a straight line, they are said to form a range of points on that line.

2°. If a set of lines all pass through the same point, they are said to form a pencil of rays through that point as center.

3°. The anharmonic, or double, ratio of a range of four points A B C D is

$$\frac{AC}{BC} : \frac{AD}{BD}$$

and is represented by (A B C D).

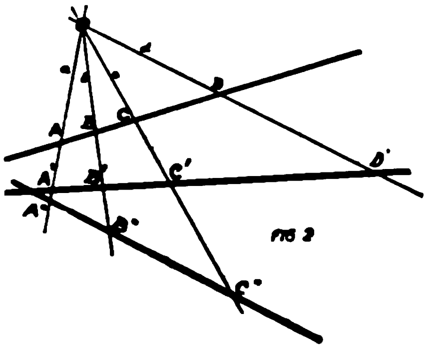
In this expression we must take into consideration the directions or signs of the segments, remembering that the segment lettered A B, for example, may be considered as described by a point moving from A to B; and therefore that $AB = -BA$. This leads us directly to the result, that if A B C are any three points of a straight line, then $AB + BC = AC$, whether B lies within the segment A C or not.

4°. When $(ABCD) = -1$, the four points are said to be harmonically related or the four points are said to divide the line harmonically.

We will now prove the fundamental property of Central Projection, namely:

The anharmonic ratio of any range of four points is unchanged by projection, i. e.,

$$(ABCD) = (A'B'C'D')$$



Call a, b, c, d the lengths of the rays from O to A, B, C, D respectively, and designate the angle between a and b by $(a\,b)$, including sign as in the rectilinear segments above.

Considering the triangles O A C and O B C, we have

$AC : BC = \frac{1}{2}\, a\, c \sin(a\,c) : \frac{1}{2}\, b\, c \sin(b\,c) = a \sin a\,c : b \sin(b\,c)$.

Similarly from the triangles O A D and O B D.

$AD : BD = \frac{1}{2}\, a\, d \sin(a\,d) : \frac{1}{2}\, b\, d \sin(b\,d) = a \sin(a\,d) : b \sin(b\,d)$, whence

$$(ABCD) = \frac{\sin(a\,c)}{\sin(b\,c)} : \frac{\sin(a\,d)}{\sin(b\,d)}$$

By the same method we find the same expression for (A' B' C' D'), and therefore

$$(ABCD) = (A'B'C'D').$$

It seems that possibly an exception might occur when the straight line on which we project is parallel to one of the rays. It is readily shown that the relation is still true under these circumstances, as follows:

Take the case where the straight line is parallel to d, then D″ is at an infinite distance.

If we consider the ratio A D : B D, it can be written A B + B D : B D = 1 + A B : B D. When D is at an infinite distance this ratio becomes unity. Therefore

$$(A'' B'' C'' D'') = A'' C'' : B'' C''$$

By considering the triangles O A″ C″ and O B″ C″, we have

$$A'' B'' : b'' = \sin (a\, b) : \sin (O\, A''\, B'') \text{ and}$$

$$B'' C'' : b'' = \sin (b\, c) : \sin (O\, B''\, C'')$$

From the Figure 2, we see that $\sin (O\, A''\, B'') = \sin (a\, d)$ and $\sin (O\, B''\, C'') = \sin (b\, d)$. By substituting these values we have the result

$$(A'' B'' C'' D'') = \frac{\sin (a\, c)}{\sin (b\, c)} : \frac{\sin (a\, d)}{\sin (b\, d)} = (A\, B\, C\, D),$$

as before.

We can consider the double-ratio $\dfrac{\sin (a\, c)}{\sin (b\, c)} : \dfrac{\sin (a\, d)}{\sin (b\, d)}$ as a double-ratio belonging to the pencil of four rays, and represent it by $(a\, b\, c\, d)$. Then in a manner similar to the above we can prove that it is unchanged by projection.

In Figure 2, we then have

$$(A\, B\, C\, D) = (a\, b\, c\, d), \text{ or}$$

The anharmonic ratio of a range of four points equals the anharmonic ratio of any pencil of four rays passing through them; and, the anharmonic ratio of a pencil of four rays equals the anharmonic ratio of any range of four points which lie on them.

It is well to call attention at this place to the reciprocal relation between the point and the straight line, which has appeared in our discussion, and to which we shall recur several times in our later development, particularly from the point of view that either may be readily considered as the fundamental space element. The point is the space element ordinarily used in the development of the elementary geometry. This idea of considering the space element as being other than a point has been one of very great importance in the modern development of geometrical investigation.

We will now call attention to a few common reciprocal forms of statement, i. e., those in which the word point is replaced by the word line and the word line by the word point, with only such other changes as may be necessary to make the form of statement correspond.

Points on a straight line, or range of points.	Straight lines through a point or pencil of rays.
A straight line is the join of two points, or	A point is the intersection (join) of two straight lines, or
A straight line is determined by two points.	A point is determined by two straight lines (not parallel).
A curve is a locus described by a moving point.	A curve is the envelope of a moving straight line.

A triangle is a self-reciprocal figure, that is, it may be considered as determined by three points or by three straight lines.

From these considerations we see that the relations between the anharmonic ratios of ranges and pencils stated above are reciprocal to each other. These examples will perhaps suffice to make the idea of the existence of a reciprocal relation in plane geometry seem plausible at least.

My first step in generalization will be to derive a theorem for a general quadrilateral from one for the parallelogram.

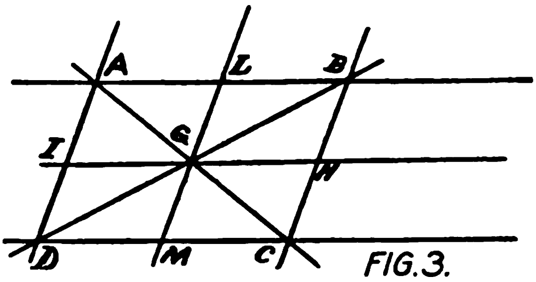


FIG. 3.

Consider the parallelogram A B C D. Through G, the intersection of its diagonals, draw G H and G L parallel to the sides A B and A D respectively. Then H and I bisect the segments B C and A D respectively. Call F the point at an infinite distance on A D, L M and B C. Recalling a result of our previous discussion, we have

(A D I F) = — 1 since

$$\frac{AI}{DI}\ \frac{AF}{DF} = \frac{AI}{DI} = -1;$$

and a similar result for each of the other three sides of the parallelogram.

Since any quadrilateral can be projected into a parallelogram, this result must be true for any quadrilateral whatevercever. For if we project so that the pencils through F and E each becomes a set of parallel lines, we have the case of the parallelogram just discussed. Therefore in the quadrilateral A B C D,

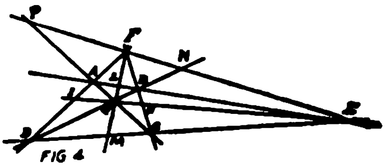


FIG 4

$$(A D I F) = -1 = (L M G F) = (C B H F) = (A B E L)$$

Also since the pencil of four rays at E is harmonic,

$$(B D G N) = (A C G P) = -1.$$

We may now state the first part of our result in the following form:

If a line be drawn from the intersection of two opposite sides of a quadrilateral to the intersection of the diagonals, either of the two remaining sides is divided harmonically by its intersection with this line, its intersection with the fourth side and the two vertices on it.

Also, for the second part,

If a line be drawn from the intersection of two opposite sides to the intersection of the diagonals, it is divided harmonically by these two points and its intersections with the remaining pair of opposite sides.

If we call the six intersections of the sides of the quadrilateral (as a four-sided figure) the vertices, and those vertices which do not lie on the same side, *opposite vertices*, as A and C, B and D, E and F respectively, and the lines through two opposite vertices by the name diagonals, as A C, B D and E F, the second part can be restated as follows:

Any diagonal is divided harmonically by the two vertices on it and its intersections with the other two diagonals.

We could easily find further harmonic properties, particularly of pencils, as of those with centers at E, F, G, but we will turn to a result which does not involve lengths but which is purely descriptive in its nature.

From the parallelogram, we know that L H, A C and I M are parallel; then in the quadrilateral we must have the result *that L H, A C and I M must all pass through a same point P on E F or all be parallel to it*, and a similar result for the three other lines I L, D B and M H, obtained in a similar way.

We have thus found two theorems for the general quadrilateral, one containing lengths, the other entirely descriptive, out of two very elementary properties of a parallelogram.

Now take Figure 4, omit the lines F G and E G and the points H, I, L, M determined by them, and construct a new figure in which lines take the places of points and points those of lines in the preceding. We obtain Figure 5, which is called the reciprocal figure of Figure 4; a, b, c, d, e, f are six lines joining four fundamental points of the four-point, and g corresponds to G of Figure 4. We can immediately state new theorems for this configuration by taking those for the quadrilateral and interchanging the words line and point, and defining opposite sides in a way entirely analogous to that for opposite vertices in the preceding.

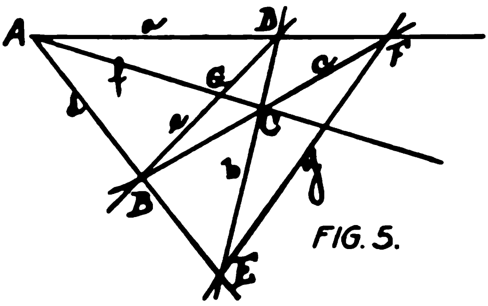


FIG. 5.

The following theorem is obtained from that for the quadrilateral of Figure 4 by this method. It can be easily proved by methods already used for the harmonic division of a diagonal.

The pencil of four rays formed by two opposite sides and the lines joining their point of intersection to the two intersections of the remaining pairs of opposite sides is harmonic.

If we letter the intersections in Figure 5, as indicated, we notice that we have a self-reciprocal figure made up of seven lines and seven points, where corresponding lines and points have the same letter.

We will now turn to some further considerations of a similar kind connected with a circle instead of with a rectilinear figure.

Take any four points A, B, C, D on a circle and join them to any two-fifth points P and P', also on the circle. We know from the properties of the circle that the angle between the pair of rays joining any two points to P is equal or supplementary to the angle between the two rays joining the same points to P'. In either case, we know that the anharmonic ratio is the same for the two pencils. Now project on a second plane from any point. The resulting figure gives a conic section instead of a circle, and two pencils of four rays with their centers on the conic section and the rays intersecting in pairs, on the conic section, one ray of every pair from each pencil. This suggests the following theorem:

If any four fixed points of a conic section be joined to any fifth point on that conic section by straight lines, the anharmonic ratio of the pencil of four rays is constant.

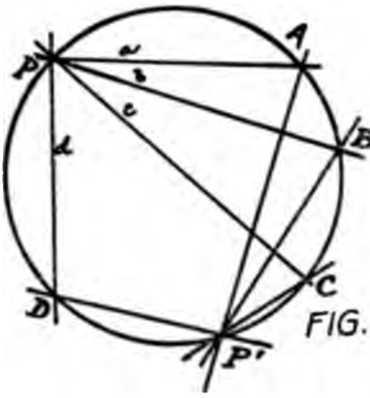


FIG. 6.

This can also be stated as follows:

If in two pencils (each having an infinite number of rays) corresponding rays are determined as those which intersect on a fixed conic section through the two centers of the pencils, then the anharmonic ratios of any two pencils of four corresponding rays are equal.

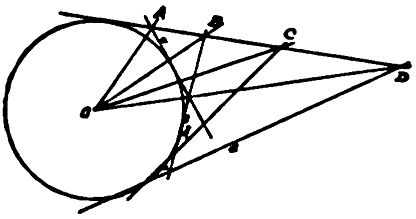
The proof of this could be obtained by using the reverse process of that stated above, beginning with the conic section and making use of the fact that any conic section can be laid upon some cone of revolution.

Turning now to the reciprocal theorem to that previously stated for the circle, using the circle again as basis, we have

If any four fixed tangents to a circle are cut by any fifth tangent, the anharmonic ratio of the four points of intersection is constant.

We will now prove this:

Join the O, the center of the circle to A, B, C, D, the points of intersection of the four tangents with the fifth. We will now prove that the angle between any pair of rays as O B and O C takes a certain value or its supplementary value, and is therefore otherwise independent of the position of the tangent A B C D.



Designating the angle between the

Lyrics and Epics.

A few selections from the lyric poetry of Goethe, Schiller, Heine and Uhland, etc. Hatfield's "German Lyrics and Ballads" (Heath & Co.).

Scheffel: "Der Trompeter von Säkkingen" (Heath & Co.).

Schiller: "Das Lied von der Glocke" (Heath & Co.).

General literary interpretation should be aimed at.

4. Conversation and Composition on the works read.

FOURTH YEAR.

1. Grammar and Syntax reviewed. (Von Jagemann's German Syntax).

2. Composition. Translation from English into German (Von Jagemann or Poll's Composition), and German abstracts and free German essays on the works read.

3. The reading of about 500 pages of standard German literature with aim at general literary interpretation. The lives of several of the great German poets should be read. The following biographies might be used for this purpose:

Lessing: Rolleston. Great Writers Series, London.

Schiller: Nevinson. Great Writers Series.

Goethe: Sime. Great Writers Series.

Heine: Sharp. Great Writers Series.

Uhland: Hewett. Introduction to Hewett's edition of Uhland's Poems. (Macmillan & Co.).

The works read might be selected from the following list:

Dramas.

Goethe: "Egmont" (Ginn & Co., Holt & Co., Macmillan); "Iphigenie" (Macmillan, Heath & Co.).

Schiller: "Jungfrau v. Orleans" (Holt & Co., Macmillan, Heath & Co.), [if not read in the third year]; "Maria Stuart" (Macmillan, Scott, Foreman & Co., Heath & Co.).

Lessing: "Minna v. Barnhelm" (Macmillan, Holt & Co., Heath & Co.) [if not read in the third year]; "Emilia Galotti" (Ginn & Co., Heath & Co.).

Heinrich v. Kleist: "Der Prinz v. Homburg" (Ginn & Co.).

Grillparzer: "Sappho" (Ginn & Co.); "Der Traum ein Leben" (Heath & Co.).

Fulda: "Der Talisman" (Heath & Co.).

Novelistic Prose.

Freytag: "Die Verlorene Handschrift" (Macmillan).

Goethe: "Sesenheim" (Heath & Co.).

Heine: Prose Selections (Macmillan, Clarendon Press).

Keller: "Dietegen" (Ginn & Co.); "Romeo und Julie auf dem Dorfe" (Heath & Co.).

Kleist: "Michael Kohlhaas" (Holt & Co.).

Kleist, Zschokke and Goethe: "Three German Tales" (Holt & Co.).
K. F. Meyer: "Gustav Adolfs Page" (Heath & Co.).
Scheffel: "Ekkehard." Abbreviated edition (Heath & Co.).

Historical Prose.

German Historical Prose: Ranke, Droysen, v. Treitschke, v. Sybel (Holt & Co.).
Schiller: "Der dreissigjährige Krieg" (Holt & Co.).
Von Sybel: "Die Erhebung Europas" (Ginn & Co.).

Epics and Lyrics.

Goethe: "Hermann und Dorothea" (Macmillan, Heath & Co.).
Goethe's Poems (Holt & Co., Heath & Co.).
Heine's Poems (Heath & Co.).
Uhland's Poems (Macmillan & Co.).

4. Conversation and Composition on the works read.

MAX WINKLER, Chairman,
University of Michigan.
HELENE CHRIST,
Grand Rapids High School.
TOBIAS DIEKHOFF,
University of Michigan.
HOWARD EDWARDS,
Michigan Agricultural College.
R. CLYDE FORD,
Michigan Normal College.

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Selected volumes of the works of GOETHE, SCHILLER, LESSING, in Kürschner's "Deutsche National-Literatur," about 75 cents a volume.
GOETHE, volumes 1–21.
SCHILLER, volumes 1–7, 10–12.
LESSING, volumes 1–3, 7, 9, 10, 12.
VON KLEIST, H., volumes 1–4.
HEINE, edited by Elster, 7 volumes, Bibliogr. Institut. $4.00
UHLAND, Poems. The Macmillan Co., 60 cents.

B. BIOGRAPHIES.

The lives of GOETHE, SCHILLER, LESSING, HEINE, in the "Great Writers Series," edited by Professor Eric Robertson. 40 cents a volume.
HERM. GRIMM: "Life and Times of Goethe," translated by S. H. Adams. Little, Brown & Co. $2.50.

Lyrics and Epics.

A few selections from the lyric poetry of Goethe, Schiller, Heine and Uhland, etc. Hatfield's "German Lyrics and Ballads" (Heath & Co.).
Scheffel: "Der Trompeter von Säkkingen" (Heath & Co.).
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Schiller: Nevinson. Great Writers Series.
Goethe: Sime. Great Writers Series.
Heine: Sharp. Great Writers Series.
Uhland: Hewett. Introduction to Hewett's edition of Uhland's Poems. (Macmillan & Co.).

The works read might be selected from the following list:

Dramas.

Goethe: "Egmont" (Ginn & Co., Holt & Co., Macmillan); "Iphigenie" (Macmilian, Heath & Co.).
Schiller: "Jungfrau v. Orleans" (Holt & Co., Macmillan, Heath & Co.), [if not read in the third year]; "Maria Stuart" (Macmillan, Scott, Foreman & Co., Heath & Co.).
Lessing: "Minna v. Barnhelm" (Macmillan, Holt & Co., Heath & Co.) [if not read in the third year]; "Emilia Galotti" (Ginn & Co., Heath & Co.).
Heinrich v. Kleist: "Der Prinz v. Homburg" (Ginn & Co.).
Grillparzer: "Sappho" (Ginn & Co.); "Der Traum ein Leben" (Heath & Co.).
Fulda: "Der Talisman" (Heath & Co.).

Novelistic Prose.

Freytag: "Die Verlorene Handschrift" (Macmillan).
Goethe: "Sesenheim" (Heath & Co.).
Heine: Prose Selections (Macmillan, Clarendon Press).
Keller: "Dietegen" (Ginn & Co.); "Romeo und Julie auf dem Dorfe" (Heath & Co.).
Kleist: "Michael Kohlhaas" (Holt & Co.).

Storm: "Immensee." Braunschweig. Westermann. 50 cents. "Aquis Submersus." Westermann. $1.25.

Rosegger: "Schriften des Waldschulmeisters." Wien. Hartleben. 90 cents. "Waldheimat." Two volumes. Hartleben. $1.80.

G. HISTORIES OF GERMANY, ETC.

Henderson: "History of Germany." Macmillan. $4.00.

Hans Meyer: "Das Deutsche Volkstum." Leipzig. Bibliogr. Inst. $4.00.

Zehme: "Kulturverhaltnisse des deutschen Mittelalters." Leipzig. Freytag u. Tempsky. 50 cents.

Putzger: "Historischer Schulatlas." Leipzig. Velhagen u. Klasing. 60 cents.

H. MISCELLANEOUS WORKS.

Schoenbach: "Über Lesen und Bildung." Graz. Leuschner. $1.25.

Eckermann: "Gespräche mit Goethe." Stuttgart. Cotta. 75 cents.

Goethe-Schiller: "Briefwechsel." Stuttgart. Cotta. 50 cents.

Nibelungenlied (Übersetzt von Simrock). Stuttgart. Cotta. $1.50.

Brueder Grimm: "Märchen." (Large edition). Berlin. Hertz. $1.00.

O. Frick: "Wegweiser durch die Klassischen Schuldramen." Four volumes. Leipzig. Hofmann. $6.00.

This list of books for a small German High School Library has been prepared by the members of the German Department of the University of Michigan at the request of the German Section of the Schoolmasters' Club of the State of Michigan. The schools are advised, as far as possible, to import the German books of this list directly from Germany, and for their guidance the following German firms are suggested: Bernhard Liebisch, Leipzig, Kurprinzstr. 6; Mayer und Müller, Berlin N. W., Prinz Louis Ferdinandstr. 2; F. A. Brockhaus, Leipzig, Querstr. 16.

It may also be stated that Mr. Gustav Stechert, 9 East 16th St., New York City, is willing to import the German books of this list at the rate of 22 cents for the mark.

Proceedings

OF THE

Michigan Schoolmasters' Club

AT THE

Fortieth Meeting

HELD IN

Ann Arbor, March 30, 31, April 1, 1905

1903

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Michigan Schoolmasters' Club

PROCEEDINGS OF THE FORTIETH MEETING, HELD AT ANN ARBOR, MARCH 30, 31, APRIL 1, 1905

EDITED BY THE SECRETARY

GENERAL MEETINGS

The fortieth meeting of the Michigan Schoolmasters' Club began on Thursday, March 30, with meetings of the classical, modern languages, and physics and chemistry conferences. The general meetings were held on Friday and Saturday mornings, March 31 and April 1. So large was the attendance that the meetings, for the first time in the history of the Club, were held in University Hall. Friday morning Professor R. M. Wenley, of the University, read a paper on "The Nature of Culture Studies." This paper was published in the *School Review*. Professor L. H. Bailey of Cornell spoke upon "The School of the Future," and Professor J. R. Angell of Chicago spoke upon the "Work in a Psychological Laboratory." Since Mr. Bailey and Mr. Angell spoke from notes, no papers could be obtained for publication.

On Friday at 4 P. M., in the Barbour Gymnasium, the Club attended a gymnastic entertainment given by the young women of the University. The exercises were in charge of Dr. Helen E. Brooks, assisted by Miss Bertha S. Stuart, and consisted of the usual class drills, closing with a basket ball game.

At 5 P. M., in University Hall, a musical recital was given by the Faculty of the University School of Music, under the direction of Professor A. A. Stanley. Numbers were given by A. A. Stanley, William Howland, Henri Ern and Albert Lockwood.

At 8 P. M., in University Hall, President Woodrow Wilson delivered one of the best addresses to which the Club ever listened. The subject, "The University and the Nation," was most appropriate, and showed Mr. Wilson at his best.

The papers read Saturday morning by Mr. W. H. Brett, of Cleveland, and Supt. S. O. Hartwell, of Kalamazoo, are printed in these proceedings.

That of Mr. E. L. Miller, of Chicago, on "The Greek in English," was published in the *School Review*.

The minutes of the business meeting and the program in full may be found immediately following the papers.

During the meetings music was furnished by the Faculty of the School of Music.

THE SCHOOL AND THE LIBRARY.

WILLIAM H. BRETT, LIBRARIAN CLEVELAND PUBLIC LIBRARY.

I am glad of the opportunity of being with you on this occasion, because it has given me the opportunity of meeting good friends I do not have the pleasure of seeing frequently, and it is especially gratifying to realize that this invitation comes to me not as a personal matter but as a recognition by you as teachers, of the library as an educational institution and one which is working for the same purposes you have in view.

The free public school is a full generation older than the free public library, and in this country a generation means much for progress. I can remember distinctly the account which my father gave me of the school which he attended in a little village in western New York. It was a square building with a door in one side and a table for the teacher. The benches on the floor, of slabs supported on pegs, and without any desks, were for the smaller children. The older ones who were writing and ciphering were provided for by a shelf, made also of a slab smooth side up supported against the wall, with similar benches in front of it. This school was supported by a subscription of those whose children attended. The thing which I remember most distinctly was my own surprise when I really grasped the idea for the first time that there had not always been such comfortable appointed school houses as those to which I was accustomed in my own native Ohio town.

Another picture which is among the most vivid in my memory is framed, so to speak, in the main school building of this same Western Reserve town. A three-story brick building on a city street, the first floor occupied by a grammar school, the second by the high school, and the third by the assembly room where Friday afternoon brought the dreadful ordeal of "speaking pieces;" a tow-headed boy who belonged in the first year of the high school seated on the steps leading up to the assembly room, furtively watching the door for the appearance of the principal, but unable to resist the temptation of following still further the fortunes of Ivanhoe. The tow-headed boy was myself, but the book I was reading was not a library book. I am quite sure that I really got more of history from the Waverly novels, and from Cooper, than I did from the text books; but my acquaintance with them

was made in small part from the few books which my good father was able to buy for me, it was made very much more from the kindness of "Good Samaritan" neighbors, and I think that as a boy I cultivated the acquaintance of most of the people in town who owned books.

I think that the surprise of my own children and the children who are growing up in these days will be scarcely less to realize that there was a time not so long ago when there were no free public libraries as my own was to think of the time when free public schools were not general.

The free public libraries of the United States had their beginning a little over fifty years ago and are largely a development of the last thirty years. The first free public library law was a special one for the city of Boston, passed in 1848, from which nothing seems to have been done. The first state library law was that of New Hampshire in 1849. Then followed the state law of Massachusetts in 1851, Maine in 1854, Vermont in 1865, Ohio in 1867. Since then similar laws have been enacted in most states of the Union.

The statistics show that there were in 1875 a little over 2,000 libraries having over 1,000 volumes each with a total of about 11,500,000 volumes. In 1885 there were 3,000 libraries with a total of 19,000,000 volumes; in 1890 3,500 libraries with about 26,000,000 volumes; in 1895, 4,000 libraries with 33,000,000 volumes; in 1900 over 5,000 libraries with over 44,000,000 volumes, while the report of the Commissioner of Education for 1903 gives 6,869 libraries with 54,500,000 volumes. The financial reports are evidently incomplete, but show as to endowments a total of over $25,000,000, and buildings to the value of over $47,000,000. The report as to income is also incomplete, but about one-third of the libraries report income aggregating a little less than $8,000,000. The progress since 1900 has been very rapid, and it is fair to assume that the financial gains have kept pace with the growth of libraries as given above. The report on books used in 1900 is probably also incomplete, but gives a total of over 58,000,000 books issued for home use.

While these figures are small as compared with 254,076 buildings for the accommodation of the common schools alone, with their property valued at $601,571,307, with their 439,596 teachers and 15,925,887 primary and grammar school pupils, as reported by the Commissioner of Education in his report for 1901-2, they will serve to give the libraries a place with the schools as a part of the educational equipment of the country.

With this great material growth of the library has come with equal step an advance in methods and an enlargement of its purpose. Cataloging and classification systems and interior library arrangements have been greatly improved. Greater freedom in the use of the library is permitted. Bibliographies, indexes, and other helps in the use of books have been devised so that the effectiveness of each book has been increased. By means of branch libraries, stations, traveling libraries, club work, home libraries for children and lectures, and other agencies, the library has become an effective educational force in the community rather than merely a depository of books.

Along with this has been developed within the last fifteen, very largely indeed within the last ten years, effective coöperation between the school and the library with the purpose of rendering the books useful to both teachers and pupils and, to some extent, to the families represented in the schools.

A very carefully conducted inquiry was made by the Librarian of the Dayton public library at the instance of the President of the American Library Association, the results of which were reported at the meeting of that association in St. Louis last October. A circular of inquiry was sent to 300 representative libraries, and responses were received from 218.

This inquiry elicited the facts both as to the work which Boards of Education are doing in supplying supplementary reading, and also the extent to which the public libraries are used by the schools. Many schools have collections, largely, however, of text books and supplementary reading. Fifteen cities supply 340,000 volumes of supplementary reading. One hundred thirty-four cities are reported as furnishing free supplementary readers, and in sixty of these class room libraries are also furnished by the library.

The report appears to be more full as to the use of books furnished by the public libraries. Twenty-five libraries furnishing class room libraries to schools aggregating 69,000 volumes, report a total annual circulation to public school pupils of 1,250,000 volumes. Thirty-three libraries report school deposit stations which are practically branch libraries for the neighborhood. Such collections vary from a few hundred to three or four thousand volumes, and are usually in schools at an inconvenient distance from other library resources. A case is reported where one such library of 30 volumes was read by nearly 500 people in three weeks. Seventy-two libraries report special collections of reference books for children. Fifty-six libraries supply catalogs and book lists on school subjects. Twenty-eight libraries have special assistants for children's reference rooms, and a much larger number report special rooms reserved for teachers and students and reservation of books for class use. The practice is almost universal in American libraries of issuing to teachers special cards on which a larger number of books may be drawn, and of giving them special privileges in other ways. The figures show clearly that in a great variety of cases and at a rapidly increasing rate provision is being made for the use of the books of the libraries by the teachers and pupils of the schools.

Another most important phase of the work, and a more recent one, is the development of plans for instruction in schools in the use of reference books, catalogs, bibliographies, and local library resources. Sixty-three libraries report such instruction. In thirty-five of these it takes the definite form of a regular course. Such courses have been given in twenty high schools and in a number of normal and grammar schools. Eight libraries offer courses to teachers and normal school students in children's literature.

I gather from the discussions at the library section of the National Educational Association that the necessity for this instruction in the use

of the library is being very generally recognized in normal schools. I observe accounts of such work from Kansas, California, Wisconsin, Minnesota, Pennsylvania, and New York. This indicates that the need of teaching the use of books is being recognized, and is one of the most hopeful indications of the whole situation. It is good to bring the child and the book together; the good will be greatly increased if the child is taught how to select the book and get what he wants from it most readily and certainly. In this I am discriminating clearly between the teaching of literature, which has so long been done in schools, and teaching how to use books, although the two go hand in hand. The value of this can hardly be estimated. It is important for the school work in hand, and even more so as a part of the equipment for the work of life, to be able to use books effectively, to reach promptly and certainly what is needed, and to estimate its value.

May I illustrate what I mean by a little account of what is done in one normal school with whose work I am somewhat familiar? For several years past the junior class has received instruction in the use of the library from one of its teachers. The course of instruction included the classification and arrangement of the library on the shelves; lists, catalog, and various bibliographies and indexes by which books are selected and found in the libraries with practice in their use; also the use of the volume itself when found; the value of what may be gleaned from the title page, chapter and page headings, marginal and other notes, the difference between the table of contents and the index; and other means by which one may judge of a book and reach what is wanted in it. It also includes the use of the fundamental reference books such as the general and special encyclopædias, dictionaries, bibliographies, indexes, gazeteers and atlases, with problems in reference work. The practice work includes the selection of books upon subjects proposed, discrimination as to the value, scope, and method of treatment in each, the writing of a brief synopsis and criticism of some one book selected from those first chosen, with reason for the selection. In history the students are taught to discriminate between source books, those which are valuable for general reading, and books for younger readers. These are fair specimens of the work which is carried on at various libraries. This is carried on parallel with the work in the school in literature. During the past two years this has been in the hands of a special teacher formerly a member of the staff of the public library, and is one of two courses given by her, the other being a course in the criticism and selection of books for children. The full result of such work will only be seen when the young women thus trained in the normal school become teachers of others.

The work thus far done has been in the main in the direction of supplying books in the schools as aids to the curriculum. The purpose with which the work was begun was to furnish supplementary reading books which would illustrate and add interest to the text book or other class work. With the development of the work, however, has come a greater recognition of its importance and a change of attitude towards it. We are beginning to see, in the words of Dr. Harris, that "The school is set at the task of teach-

ing the pupil how to use the library in the best manner—that, I take it, is the central object towards which our American school methods have been unconsciously guided."

The functions of the public library, in the new conceptions of its work, are to assist the school in its work for its pupils throughout school life, and further and still greater than this, to give to the whole community, including these same pupils when through with school, the opportunity of continuing their education throughout life.

The schools are for children and youth; the library for life. The correlative to such recognition of the library is the recognition on the part of the school that the use of books is not alone an auxilliary to the text book in the curriculum, but that the teaching of the right use of books is one of the most important purposes of the school; that it is not merely an adjunct, but an end. This changes fundamentally the attitude toward the library in and outside of the school.

The situation may be summed up as follows: For the past fifteen years or a little longer, but mainly within the last ten, there has been a growing use of the library by the schools, and efforts in various cases on the part of the library to become more useful to the schools; these two efforts have been marked by earnestness and sincerity on both sides, but have been tentative and various in methods and in effectiveness. The interest has extended very widely, and the total accomplishment has been considerable. The number of books placed at the disposal of the schools is a very large one. There have also been the valuable efforts noted to give instruction in the use of the library on the part of normal and high schools and libraries, but much less has been accomplished along this line. The significant thing, however, does not lie in what has been accomplished, but in the fact that the schools and libraries have found each other and are earnest and eager to work together. It remains now to devise the best methods for coöperation. This will take time, earnest effort, trial, failure, no doubt at times, but that it will be worked out successfully I do not question.

One promising method of bringing this about, and one which is in successful operation in various places, is the combination of the public library and the school library in the high school or larger grammar school building. A room convenient of access both from the interior and exterior of the building, well lighted and appointed, with a permanent reference collection for the use of the school and a deposit of books from the public library for the school and public use, the hours so arranged that the public use does not interfere with that of the school use, and by this combination of interest the library is made effective both to the school and the neighborhood at the least possible expense. Such plans are in operation in some high schools, and may well be extended to the larger grammar schools. If in addition to this a reading room may be opened, not for the idler over the daily papers, but supplying the better class of periodical literature, it would add to the value.

The open library, the reading room, provisions for the reading and

debating groups of the neighborhood, and other similar work, would go far to make the school of each district a social and civic center, would attach the people of the neighborhood to them, and give an interest which they cannot now have in them, standing as they do sombre, unlighted, and unused during the evening and holiday hours of the week. This has been done in some instances. I wish I had time to tell you of the good accomplished in one school in Chicago of which I happen to know by the efforts of one devoted woman. The desirable thing is to furnish the means, the opportunity in each of the school buildings for the use of books. A permanent collection of the fundamental reference books at least, and of such other books as are used so continuously and permanently, supplemented by deposits of books from the public library for temporary use. The whole to be kept in close and vital connection with the library so that the pupils may realize that it is a part of the library work and that the whole resources of the library are at their command, and that they may naturally pass along from the smaller to the larger library, and just as naturally continue the use of this after they leave school.

Such an arrangement would need the services of a teacher-librarian in each school, and would render more necessary the development of such instruction in the use of the books and of the library as that already outlined. Some instruction in the use of books might be given in the higher grammar grades, still more in the high school, and should certainly be amplified and more thoroughly extended in the normal school, for the pupil there will soon be teacher and use her knowledge of the methods of using books for the benefit of her pupils and will in turn impart to them. From these normal school graduates most apt for library work could be trained the teacher-librarian for the school libraries. While the value of such work in the school appears to me to be great, I realize that your opinion ought to be better than mine. From my point of view I can foresee great possibilities of increased usefulness for the library in this connection with the schools. I realize that such plans will take time and involve large experimentation. The library and the school will work together in this for the same end, and there should be no practical difficulties in arranging all the financial questions and administrative details involved. One of the forces in the direction of such coöperation is the library section of the National Educational Association. This was organized, as you all doubtless know, at the Buffalo meeting in 1896, and has met annually since. The department meetings have grown in numbers and interest annually. At the Detroit meeting in 1901 a very interesting paper was read by the librarian of the College of Education of Chicago on library instruction in normal schools. The sessions at the St. Louis meeting in 1904 were especially interesting and valuable. Although I have no doubt that the members of this club are very largely in attendance at the meetings of the National Educational Association, I can hardly hope that in the very many important general meetings which demand attention there these particular meetings can receive much attention from you. The fact, however, that such recognition is given to the library in the great

National Educational Association is an important one, and a similar recognition in the programs at the meetings of the various state meetings would go far to promote effective coöperation. Persistent, earnest work, by teachers and librarians with mutual respect and good will, and willingness to make concessions as to questions of expense and authority, will work out by degrees, whether along the lines I have suggested, or other still better, a greater, more effective and valuable use of books in schools, and beyond the school.

DISCUSSION.

H. O. SEVERANCE, UNIVERSITY OF MICHIGAN LIBRARY.

One of the main purposes of education is to teach pupils to read, to create in them the reading habit. The text-books form the basis of this work, but to accomplish the best results the teacher must secure help outside of the text-books. Supplementary reading in all the grades has added materially in bringing about the best results. One of the purposes of the school library is to furnish material which will supplement the text-books, not in reading alone but in other studies as well.

The libraries in most of the rural districts are small, and, possibly, it does not seem worth while to give them any attention. The same is true, but not to so large an extent, in the high schools where there is no public library. But teachers will find that by giving attention to these small and seemingly insignificant collections, they may be made to serve the best interests of the schools. A few of the best reference books, some fiction, stories of travel and adventure will help to interest the pupils in the school.

When these books are loaned out and are carried into the homes of the children, the parents read them, their attention is drawn towards the school and the teachers. While such libraries are primarily for the pupils, yet it is hoped that the parents also may be helped, and become interested in good books and in the school.

The first thing for teachers to do to make the library the most useful, is to classify the books in a simple way and familiarize themselves with the contents. If the library should contain several hundred volumes, then a card catalogue of the collection should be made which should include all authors, editors, and translators, titles and subjects. The fewer the books in a collection, the more minutely should the books be analyzed. Printed cards for most of the books can be had from the Library of Congress at the very small price of two cents apiece for the first card and one-fourth cent for each duplicate card.

One of the best guides for this work is the "A. L. A. Catalogue of Books," containing a list of 8,000 volumes. It is free to all libraries. Address, Librarian of Congress, Washington, D. C.

The book contains

1. The decimal and expansive systems of classification and the titles of 8,000 volumes arranged in classes. Also the same arranged as a dictionary catalogue.

2. Prices, publishers and dates of publication.

3. Call numbers for the Library of Congress cards. Some other books which would be useful are the manual put out by Miss G. M. Walton, librarian, Normal College, Ypsilanti; and Surrat's School Libraries, published as a bulletin of Baylor University, Waco, Texas.

Nothing will add more to the interest in the library than the addition of new books to the collection. This may be done in three ways:

1. By taking heed to secure all the money due the district from "fines for breach of the peace," which in many cases amounts to a considerable. Every school district is entitled to a share of the fines for the breach of the peace. Such fines are to be used for the purchase of books for the school districts and for no other purpose.

2. The proceeds of school entertainments and socials may add a considerable number of books to the library.

3. The school board may appropriate a small amount for the purchase of books.

Another means of securing fresh reading for schools libraries is to enter into relations with the State Library so that the traveling libraries may be sent to your library. Every school library in the State under certain conditions, may secure the loan of a traveling library of 50 volumes of well selected books, from the State Library. After the books in the first library have been read a second library may be had in the same way and so on.

Libraries may be had from the State Board of Library Commissioners by the registration system. Every library containing 100 volumes, by registering with the commission, may borrow 100 volumes from the secretary. These books may be kept six months. Then, if any books have been added to the library in the meantime, a loan of another 100 volumes may be secured.

By these means it is possible to secure 50 new booke four times per year at least, for the readers in every school district in the State.

If every district school teacher in the State would take the matter in hand, every child in the State would have a collection of good books accessible to him at all times within an hour's walk.

DISCUSSION.

SUPERINTENDENT H. M. SLAUSON, ANN ARBOR.

Superintendent Slauson said that, in his opinion, the great problem is to get children to read the *right* books. Investigations into the amount of reading that school children are doing show that many are really reading more than they can possibly digest, the majority are reading enough and only a small proportion need to read more. It is the quality, not the quantity,

of school children's reading with whch we need to be concerned. Grown people are influenced to read new books by skillful advertising in the form of book reviews, by expressions of opinion from their friends and by judicious displays on open shelves in libraries and book stores. We cannot employ quite the same means for interesting children but we need to give just as much thought to our methods as do the publishers and the book dealers, that is, we must work on business methods.

Children should have books that are suited to their mental and moral stages of advancement. It is of little use to give a child a book that is far above either his mental or his moral stature; usually he will not read it, and, if he does, it is not at all likely to produce any beneficial effects. From a moral point of view, the best book for any child is the one that, judged by its morality, just measures up to the highest plane that he is capable of appreciating and that will make him capable of appreciating a better one, after reading it.

A librarian can do much through personal influence to guide the reading of the children of a community. Open shelves and a wise attendant may do what the book dealer does with grown people.

The teachers of the public schools have the best opportunity of all the agencies available. They may place lists of suitable books before the school children, may give credit for reading that the children may do under their direction, and may encourage home and vacation reading.

In Ann Arbor, the patrons of the public library are chiefly the school children. Twenty-seven per cent of them are in the high school, thirty-three per cent are in the grades, and the remaining forty per cent are adults. Of our high school enrollment seventy-four per cent are library patrons; of the grades, twenty-five per cent. If this is an unusually large proportion of school children as patrons, it may be due to the fact that the library has, for years, been situated in the high school building and, thus, the teachers have had unusually good opportunities for exerting the influence to which I have referred.

ATHLETICS IN MICHIGAN SECONDARY SCHOOLS.

SUPT. S. O. HARTWELL, KALAMAZOO.

The Committee on High School Athletics, to whom a revision of present athletic arrangements was entrusted at the State Association in December, 1904, made their report at the Schoolmasters' Club April 1st. The report was adopted and the new arrangements and revised rules go

into effect with the opening of the foot-ball season next fall. The main provisions are:

I. That the University Athletic Association, through the Inter-scholastic Manager, should keep the management:

(*a*) Of track and field athletics,

(*b*) Of the Thanksgiving Day game,

and that the Inter-scholastic Manager should also be responsible for securing officials when asked to do so by the Athletic Director.

II. That for forming a foot-ball schedule (and for base-ball if the sections should later so wish) the State should be divided into sections. The first division is the Upper Peninsula, which will make its own sections and schedules as hitherto. The second division or Lower Peninsula is divided into eight sections comprising the following counties:

LIST OF COUNTIES.

1. Lenawee, Livingston, Monroe, Oakland, Washtenaw, Wayne.
2. Branch, Calhoun, Eaton, Hillsdale, Ingham, Jackson.
3. Allegan, Barry, Berrien, Cass, Kalamazoo, St. Joseph, Van Buren.
4. Kent, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Ottawa.
5. Bay, Clare, Clinton, Genesee, Gladwin, Gratiot, Isabella, Midland, Saginaw, Shiawassee.
6. Huron, Lapeer, Macomb, Sanilac, St. Clair, Tuscola.
7. Alcona, Alpena, Arenac, Cheboygan, Crawford, Iosco, Montmorency, Ogemaw, Oscoda, Otsego, Preque Isle, Roscommon.
8. Antrim, Benzie, Charlevoix, Emmett, Grand Traverse, Kalkaska, Lake, Leelanau, Manistee, Mason, Missaukee, Osceola, Wexford.

III. In each section a committee has been appointed to secure the organization of the section with the co-operation of as many schools as possible before the close of this term. The schools in each section which agree to enter an athletic league and be governed by the rules which have been adopted by the High School Section of the State Teachers' Association, shall organize by selecting a committee of three, which committee will arrange schedules of athletic contests within the section, and act as a board of appeals on any disputes arising between schools in that section. Section contests must be completed so that a representative team for each section shall be selected by a date to be mentioned by the Athletic Director, which date for the fall foot-ball schedule this year will be November 6, 1905.

IV. The completion of schedules, choice of places for games (in case schools cannot agree) and general arrangements for inter-district contests shall be in the hands of the Athletic Director, Principal C. G. Wade of Flint. His rulings are to be complied with, but protest after a game may be made through him to any one member of the State Committee not in the districts concerned. Eligibility protests in inter-district contests shall be referred to the State Committee in the same way, through the Athletic Director.

V. The present Board of Appeals is abolished. The rules have been

rearranged and simplified with practically no change in meaning. The North Central Association of Colleges and Secondary Schools has lately made 20 years instead of 21 the age limit for high school athletics. It would be helpful if Michigan should adopt that change another year. While there are still some points in this plan of management that will need the test of experience, your committee believes that the main point desired by the schools has been secured, namely, a more thorough representation in the general management. It is sincerely to be hoped that the schools interested in athletics will strive to make that management judicial and impartial.

Respectfully,

S. O. Hartwell,
L. L. Wright,
D. W. Springer,
A. J. Volland,
Webster Cook,
Committee.

RULES GOVERNING MICHIGAN SECONDARY SCHOOL ATHLETICS.

Personal Eligibility.

1. No person shall be qualified to represent any school under this agreement in any athletic contest with members of another school or other schools unless he shall have been enrolled as a member of the school from the first of October or the first of March in the semester in which the contest or event takes place. Students over twenty-one years of age when enrolled for the semester shall be excluded from participation in inter-school contests, and no student shall play on secondary school teams or contest in secondary school athletics for more than four years.

2. No person who has represented any school in inter-school contests in any capacity during a semester and whose school connection has lapsed shall be again eligible to represent such school in any athletic capacity until he shall have been in regular attendance for a whole semester. Absence for more than two weeks for any reason other than disabling sickness shall be deemed "lapse of school connection" under this rule. (Doubtful cases should be referred to the proper Board of Appeals.)

3. Any person who has ever used or is using his athletic skill, or skill in athletics, for gain, or who has competed on any college athletic team, shall be barred from participation in any inter-school contests. Any student going from one secondary school to another must present a certificate from the superintendent or principal of the school left, showing his eligibility under the athletic rules, before being allowed to compete in any contests.

4. All candidates for membership in foot-ball teams may be required to pass a physical examination and have their parent's consent to play.

School Standing.

5. No student shall be allowed to represent his school in athletics in any capacity whatever unless his marks, from the beginning of the semester to the time of the game to which he is certified, shall average the grade designated by said school as passing, in each of at least three studies comprising not less than twelve hours of credit work per week. (In determining credit, laboratory work may count for one-half.) The average standing to be determined according to the system in operation in each particular school.

6. Any student failing to pass at least ten hours of his school work during any semester shall be ineligible to play or contest in any inter-school contests until his record shall show ten hours for that semester completed according to the rules of the school.

Concerning Schools.

7. A principal's or superintendent's certificate as to the standing of the representatives of a school under this agreement shall be required before every contest. Each candidate for a team shall sign a statement giving the day, month and year of his birth and certifying his eligibility under Rule 3. This statement shall be taken as a legitimate basis for the principal's or superintendent's certificate until evidence to the contrary is found.

8. Any school failing to meet a game scheduled without giving a week's notice shall be barred from competition in inter-school series of games or contests for one year (subject to decision of Board of Appeals).

9. The entire management of high school athletics shall be vested in students or teachers.

Concerning Contests.

10. Either team in a foot-ball contest may demand an official or officials from the Athletic Director, the expense to be divided equally between the two teams.

CONFERENCES

CLASSICAL CONFERENCE

The Eleventh Classical Conference was held at Ann Arbor, Michigan, on Thursday and Friday, March 30 and 31, 1905. All the sessions of the Conference were for the first time held in Sarah Caswell Angell Hall, which will probably be the regular place of meeting in Ann Arbor hereafter. There was a good attendance, representatives being present from many high schools and private schools, several normal schools, and a dozen colleges and universities in the states of Michigan, Ohio, Indiana, Illinois, Iowa, Pennsylvania, New York and New Jersey.

The regular sessions of Thursday morning (commencing at eight o'clock), Thursday afternoon and Friday afternoon were given to the reading and discussion of papers. Thursday afternoon at 4:30 o'clock Professor Andrew F. West, of Princeton University, gave an address on "The Lost Parts of Latin Literature"; on Thursday evening, a joint session of the Classical and Modern Language Conferences was held, to listen to an address by Professor William Gardner Hale, of the University of Chicago, on "Prevailing Methods in the Study of Mood-Syntax in the Indo-European Languages," which was preceded by an interpretation of the remains of ancient Greek music. At the close of the address an informal reception was held in the parlors of the Barbour Gymnasium.

At three o'clock on Friday, Professor Arthur Fairbanks, of the University of Iowa, delivered before the Conference an illustrated lecture on "The Elusinian Mysteries"; and at four o'clock the audience was favored with another lecture, also illustrated, by Professor James C. Egbert, of Columbia University, on "The Ara Pacis of Augustus and its Restorations."

The presiding officers of the various sessions were: Thursday morning, Professor Francis W. Kelsey, of the University of Michigan; Thursday afternoon, Principal Lawrence C. Hull, of Michigan Military Academy; Thursday evening, Professor A. G. Canfield, of the Department of Romance Languages, University of Michigan; and Friday afternoon, Professor R. M. Wenley, of the Department of Philosophy, University of Michigan.

Five of the speakers made use of illustrations with the stereopticon; and two others presented large and carefully prepared drawings. Two of the papers, by Professor R. M. Wenley and Mr. Edwin L. Miller, which had

been prepared for the Classical Conference, were read at the general sessions of the Schoolmasters' Club on Friday and Saturday mornings.

Many of the most important addresses and papers were published in the recent numbers of the *School Review*.

CONFERENCE OF PHYSICS AND CHEMISTRY

REPORT OF THE COMMITTEE ON A "LIST OF EXPERIMENTS" FOR BEGINNING CHEMISTRY

It did not seem best to the committee to mention or refer to text-books and laboratory manuals for obvious reasons, but it has been the aim of the committee to propose a list that could be followed by teachers using the various text-books now found in the schools. The list is not intended as a laboratory manual, but embodies the committees's idea of the order of subjects and experiments, and it seemed best to indicate the experiments as briefly as possible in order to allow the teacher to carry out the details in his own way. It has the defect that it leaves some doubt as to the exact amount of work to be done, but on the other hand it leaves the teacher considerable latitude to use experiments from various sources and especially to develop his own experiments. For example:

Experiment 1. Bunsen Burner.

The student should become familiar with the construction of the burner, the peculiarities of the flame (the phenomena of striking back) and know the hottest part and that there is no combustion in the central zone, etc. There are a number of experiments in the various text-books that cover these points and others can be readily devised. The oxidizing and reducing flames are best studied when the student has had more chemistry.

Experiment 4.

The idea is that the student is to perform a sufficient number of experiments to give him a good idea of the difference between a mixture and a compound. It is hinted that the interesting experiment with "gunpowder," separating by dissolving out the saltpeter with water and sulphur with carbondisulphate, and the familiar one with iron filing, and sulphur, are the kind of experiments wanted. These may be replaced by better ones or more may be added as the teacher thinks best.

Experiment 6.

"Weight of a liter of oxygen" can be done in various ways, fully described in text-books and manuals, so it is not described but left to the teacher's choice. It is suggested that each school should have a small reference library of the most common books and it might be well for the conference to discuss this point. It is hoped that the appended list will be thor-

oughly discussed and may form the starting point of a thorough study of the teaching of chemistry by the teachers of Michigan.

G. A. Hulett,
G. O. Higley,
F. C. Irwin,
B. W. Peet,
Committee.

LIST OF EXPERIMENTS FOR BEGINNING CHEMISTRY.

1. Bunsen Burner. (Omit oxidation and reduction).
2. Simple work in cutting and bending glass. Construction of a wash bottle. Use of cork borers.
3. Measurement of mass and volume and their relations (specific gravity).
4. Physical and chemical change.
   (a) Mechanical mixture. (Gunpowder, iron and sulphur).
   (b) Chemical compound (Iron and sulphur).

Oxygen.

5. Preparation from mercuric oxide, potassium chlorate, and from the chlorate and manganese dioxide mixed.
   (Method of collecting and handling gases).
6. Properties of oxygen. Test with a splinter. Burn carbon, sulphur, phosphorus. Test reaction of water solution of oxides.
7. Weight of a liter of oxygen.
   Oxidation (Quantitative) (a weight of oxygen that combines with unit weight of magnesium).
   (b) Combining weight of iron determined by oxidation with nitric acid, igniting and weighing as ferric oxide.

Hydrogen.

8. (a) Action of sodium on water.
   (b) Action of iron on water (Instructor).
   (c) Action of metal on acid.
9. Equivalent weight of magnesium and zinc.
   (Gas laws for those who have had no physics).
10. Show that dry hydrogen burning in air produces water.

Water.

11. Purification of water.
    (a) Filtration.
    (b) Distillation.
12. Water as a solvent. Solution and chemical action.
13. Water of crystallization. (Quantitative.) *e. g.*, sodium sulphate or copper sulphate.
14. Composition of water.
    (a) By volume—electrolysis.
    (b) By weight—copper oxide method.

15. Law of Definite Proportions. (Conclusion from Expts. 13 and 14 and some other experiment.)

Chlorine.

16. Electrolyse common salt solution. (Teacher's experiment.)
    (Method given in proceedings of chemical conference).
17. (a) Preparation from manganese dioxide and hydrochloric acid.
    (b) Preparation from bleaching powder.
18. Properties of chlorine. Combustion of hydrogen, phosphorus, antimony and sodium in chlorine.
19. Chlorine water. Bleaching.

Hydrochloric Acid.

20. Preparation.
    (a) See 18.
    (b) Sodium chloride and sulphuric acid.

    Properties:
    (a) Solubility in water. Saturate 5 grams of water in a weighed test tube surrounded with cold water and weigh, also measure the volume of solution and calculate the specific gravity.
    (b) Action on litmus.
    (c) Action on iron, zinc, magnesium, and copper.
    (d) Action on bases.
21. (a) Properties of Acids.
    (b) Properties of Bases.
    (c) Properties of Salts.
22. (a) Neutralization. Quantitative.
    (b) Ionization.

Atmosphere.

23. (a) Analysis by alkaline pyrogallel.
    (b) Test for carbon dioxide.
    (c) Test for water. (KOH.)
    Hint: Plants absorb carbon dioxide and give up oxygen.

Nitrogen.

24. (a) Preparation from air and hot copper. (Instructor.) See also 23a.
    (b) Preparation from sodium nitrite and ammonium chloride.

Ammonia.

25. Preparations—by heating ammonia water.
    Properties: Solubility in water. Test with hydrochloric acid on a glass rod. Litmus and odor.
26. Prepare an ammonium salt and decompose by heat.
    Treat ammonium salt with a fixed alkali.

27. Teacher's experiments.
   (a) Decompose ammonia by chlorine.
   (b) Decompose ammonia by sodium hypobromite ($NaBrO$).
   Note.—To make sodium hypobromite. 10 grams of sodium hydroxide plus 100 c.c. of water cooled well, 6 c.c. of bromide added, keeping solution cool.

Nitric Acid.

28. Preparation.
   Properties:
   (a) Oxidizing power on ferrous sulphate.
   (b) Oxidizing power on sulphur.
   (c) Solvent power on metals, copper and iron.
29. Analysis of nitric acid. Prove that it contains:
   (a) Hydrogen ions.
   (b) Nitrogen. (By the action of aluminum on sodium hydroxide and adding nitric acid, ammonia is liberated).
   (c) Oxidation of ferrous sulphide or sulphur.
   (Method given in the proceedings of the chemical conference). Test for nitric acid. (Ring. test.)

Oxides of Nitrogen.

30. Nitrous oxide. Preparation from ammonium nitrate.
   Properties.
31. Nitric oxide. Preparation and properties. Solubility in ferrous sulphate. (Explanation of the ring test.)

Halogens.

32. Preparation of (a) Bromine and (b) Iodine. (See Chlorine Expts. 16 and 16). Preparation of hydrofluoric acid and demonstration of its etching power. Displacement of the halogens by each other. (Periodic System).

Sulphur and its Compounds.

33. Sulphur.
   (a) Action of heat upon sulphur.
   (b) Distillation, allotropic modifications.
   (c) Solubility in water, carbon sulphide, etc.
   (d) Formation of ferrous or copper sulphide.
34. Hydrogen Sulphide. Preparation from ferrous sulphide.
   Products of combustion in air. Experiments to illustrate the use of hydrogen sulphide as a reagent in qualitative analysis.
35. Sulphur Dioxide. (a) (See Expt. 2). (b) Preparation from copper and sulphuric acid. Under properties show that it is an anhydride, and that it has bleaching properties. Form a sulphite. Oxidize it to the sulphate.

36. Sulphuric acid. Prepare in a bottle (concentrated nitric acid and sulphur dioxide; add a drop of water).

Properties:

(a) As a dehydrating agent.

(b) As an oxidizing agent.

(c) As a decomposing agent upon salts.

Normal and acid salts.

Tests for sulphuric acid.

Insoluble sulphates.

Phosphorus.

37. Compare yellow and red phosphorus. (Consider the preparation of phosphorus from a phosphate). (Instructor manufacture matches).

Study meta, ortho, and pyrophosphoric acid.

Arsenic.

38. Reduction of arsenic trioxide with carbon. (Instructor show arsenical pyrites, orpiment and regular).

Carbon.

39. Preparation of charcoal from wood.

Decolorizing property of charcoal.

Carbon a reducing agent.

40. Carbon Dioxide. Preparation. Test properties of gas

Show that it supports the combustion of sodium and magnesium.

Solubility in water.

41. Normal and bicarbonates.

(Calcium hydroxide plus carbon dioxide in excess). Discuss the geological significance of this reaction.

42. Quantitative. Per cent of carbon dioxide in calcium carbonate. (One method suggested in proceedings of chemical conference).

43. Distillation of soft coal. (Teacher's experiment).

Collect tar and show test for carbon dioxide, hydrogen sulphide and ammonia. (Method given in the proceedings of the chemical conference).

Typical Study of a Metal.

Copper:

(a) Prepare copper from copper oxide before the blowpipe.

(b) Prepare copper from copper sulphate electrolytically.

(Note.—Make brass).

Physical properties of copper. Color, malleability, etc.

Solubility in dilute and concentrated hydrochloric, nitric, sulphuric and acetic acid.

Action of hydrogen sulphide on solution of copper and separation of copper from zinc in brass.

Preparation of copper sulphate crystals from copper.

Determination of water of crystallization.

Preparation of copper nitrate crystals and decomposition by heat.

WHAT SHOULD BE TAUGHT IN BEGINNING CHEMISTRY.

PROF. F. C. KEDZIE, MICHIGAN AGRICULTURAL COLLEGE.

By plotting the path of scientific educational progress from earliest times to the present we shall find its movement has been centripetal—from the orbit of the farthest planet to the work of the newest discovered microbe.

Astronomy was an exact science long before chemistry had become distinguishable from charlatanry.

Each progressive step is one by which some fact is developed affording us a clearer insight into our surroundings, giving us more exact knowledge of how we stand related to the soil, atmosphere, and plants. If we compare the few who now pursue astronomical study with the members who study matters closer at hand it will show us the mighty change in educational ideals from the past to the present.

Manual training in the high school is here, agriculture even in the common school is coming. We say to ourselves at our clubs and conventions that "we teachers" have accomplished these changes and betterments, but in my opinion it is not the teachers but the pressing demands of the progressive practical citizen who has forced these alterations in our school and college courses.

While the many changes in the curriculum of study hinted at have been made, chemistry itself during the past 50 years has grown from a subject formerly presented only in the lecture hall in the form of a wonderful and interesting set of lectures and demonstrations accompanied by an appropriate number of explosions more or less thrilling in character, to a more quiet study of simple phenomena in the laboratory by the student himself. The lecture hour is now used mainly as a guide to the student for his individual research later in the laboratory.

What the beginner in Chemistry shall first study is not a matter of prime importance provided it be something with which he can easily and safely experiment, and of which he has had previous familiar knowledge. In short something the beginner "knows all about" but can add to what he knows by your help.

A beginning must be made at some point in the student's horizon of experience, and it seems reasonable that the more familiar the object studied the easier it will be for the beginner to get clear conceptions.

Oxygen, the all-pervading, all-important element, seems logically to deserve first consideration. For several years past I have led the beginners' attack on the subject by a study of air and the action of the common metals, copper, iron and zinc when heated upon it.

Difference of point of view may lead many teachers to adopt some other avenue of approach. At the Michigan College of Mines, Dr. Koenig draws his first conclusions from the "lesson of limestone"—comparing physical

and chemical properties by illustrative experiments involving a study of crystalline form and showing action of calcite on light, action of heat on the powdered mineral and then of acids. His second lesson is drawn from hardwood ashes.

The Greek proverb says "Know thyself," and its suggestion may well be followed in the choice of elements to be studied by the beginner. Taking the elements which compose the mass of organized materials we have C, O, H, N, Cl, S, P, of the non-metallic class, K, Na, Ca, Mg, Mn, Fe, of the metals. Besides these elements necessary to the growth of animals and plants we should also include the balance of the halogen and carbon group and the important useful metals.

One of the most essential truths which should be emphasized from the start and which the teacher himself should fully realize is that Chemistry is a practical science and does not exist in any text-book, and that its truths are of far greater practical importance outside of the laboratory than they are inside. Bring out strongly the idea that we live our daily lives surrounded by chemical changes unseen and unnoticed by us which all our laboratory study but partially fit us to comprehend, and which we are likely never to entirely appreciate. Whenever possible introduce an experiment which touches the daily life. Fresh well water filled into a glass flask with vigorous green leaves placed in bright sunlight will yield enough oxygen in the course of a few hours to cause the spark on a splinter to glow and will give the beginner a glimpse of the work in nature's laboratory. There is more carbon in the atmosphere than in or on the earth's crust. Eight tons of carbon exist as CO_2 over each square acre of the earth's surface.

Determination of the amount of water of crystallization is a good laboratory exercise but let the beginner also determine the per cent of water in a hard boiled egg, a piece of bread or a bit of fresh beef. His ideas will be enlarged regarding how much liquid (water) constitute what we commonly speak of as *solid food.*

Make the experiments in lecture room and laboratory simple and direct. Do not use a complicated compound to accomplish what a more simple substance will do. Use hot reduced copper and not alkaline pyrogallol for absorbing O in analysis of air if you have or can rig the proper working apparatus. Derive every conclusion at the start from direct experiment. Do not make a statement and then endeavor to prove the truth of your statement by an experiment—the experiment should come first and the truth be derived from logical steps from the result of the experiment. Progress by this method is slow but sure. The principal advantages gained are:

1. The beginner must understand what are the details of the experiment (training observation).

2. He will reason for himself.

3. He does not learn the truth from a statement made by you, but from an observation made by himself.

The exact order in which the first elements are studied is not of supreme importance, but let there be some logical connection in the order in which

you consider the elements which will appeal to the student's mind. Study the more common substances first. As an example we will suppose that we start with air and find that hot metals will take something from the air which causes the metals to gain in weight and the air to lose its power of letting a candle burn in it. We ask our beginner what other substance next to air is most common—on his replying that water is the substance we then show that water passed over hot metals undergoes a similar change such as the air experienced and that a gas is obtained which does not allow a candle to burn in it, while at the same time the heated metal has gained in weight and appears as though it had been heated in air. The student without difficulty infers that air and water therefore contain a common kind of matter, although he has not yet seen it but simply its effects, and that the gaseous portion not absorbed by the metal from air and that unabsorbed from water while both are colorless and extinguish flame can be easily distinguished by the burning of one gas that, from water, on testing with a taper, and the negative result with the other obtained from air.

You remark, "But all this is no novelty—it is all in print in our text books." True, indeed! This experiment studied by the student from the printed page is of little value—if, however, it is brought before him by actual performance in the lecture room or laboratory it leaves a lasting impression and serves as a sound basis for a beginner's knowledge of the two greatest objects of study—air and water.

The decomposition of water by electrolysis might follow next, then a study of O and H by themselves, including methods for their easy preparation. We then pass to the study of solid common salt and contrast its stability with the unstable compound which yielded O for our experiments, $KClO_3$.

Determining that heat alone will not affect salt—it is dissolved in water and electrolyzed, yielding by double decomposition with the water—Cl—H and NaOH. Next should follow the work with HCl and Cl, (I put HCl before Cl because it is more simply prepared and because the student can appreciate better how salt acting on H_2SO_4 yields HCl gas—after experimenting as he has just done with the action of zinc on H_2SO_4.

I need not detail further how by various natural relationships other elements may be taken up and studied, but progress should always be by stepping stones—not so far removed from each other that the distance will appear to require a jump by the beginner. We *do not* want him to "jump at conclusions" and so aim to have his progress steady and gradual.

Many of the earlier expounders of chemical knowledge filled the first third of their books with matter relating to the general properties of matter, including also chapters on heat, light, electricity, etc., which many of us nowadays require the beginner to have previously studied under the title of "physics." I have found it best to supplement this knowledge by direct physical experiments wherever they have some specially important chemical bearing.

For example, the evolution of heat by chemical combination becomes familiar to the student as he progresses in laboratory work, but that there is a quantitative relation is generally overlooked. A simple experiment which brings the quantitative side prominently forward in the action of HNO_3 on reduced copper saved from the copper oxide reduction experiments.

Using 10 c.c. of HNO_3 in test tube with a thermometer for stirrer I found that dropping into it ½ gram copper gave a rise of 15.4°. Repeating the experiment with a different weight of copper but same quantity of acid I obtained a rise of 31° and ask my beginners how much copper used. 1.006.)

Nothing is more fundamental than Avogadro's hypothesis. For the beginner to comprehend this theory he must know that all gases have the same expansion coefficient.

Professor Hofmann's apparatus illustrates the general fact of equal expansion of all gases for equal increments of temperature admirably, but does not give us any means of arriving at the figure .00366 (the mathematical coefficient) which we use so often in our calculations. Lately I have tried to determine this constant by such crude apparatus as a glass flask of known capacity plunged into a hot water bath, collecting the gas expanded over the same hot water bath in a graduated tube. Here are two results from my note book: Air .0036, H. .0038.

The idea of concrete molecules of gases and molecular motion the beginner best gains by comparison of their velocities by simple experiments in gaseous diffusion—helped out by the failure of an effort to force the molecules through the porous septum by direct compression. Further knowledge regarding molecules is added to by experiments in weighing the gases under like conditions. We found last term O weighed 15.68—Cl 35.29—N 13.92 times H. Having found the weight of a litre of H and Cl gases we next weigh HCl gas and ask ourselves how we explain the fact that one litre of Cl plus one litre of H weighs enough to make two litres of HCl gas—splitting of the molecules—the idea of atoms established.

So far I have taken your time in discussing what is largely brought out in the lecture room period. Far more important and much more difficult to carry forward with large classes is the laboratory work. The first two or three laboratory experiments should be performed under the direct personal direction of the teacher but without the use of any guide in the nature of a manual or printed sheets. The beginner will then pay better atttention to what he himself is doing and less to what the directions say he should do. He will also be more observant of what is taught him at the lecture or recitation period.

From the first I have felt that carelessness on the part of the student was induced by a course in "phenomena experiments." By this expression I mean that kind of experimentation on the part of the student in which he is to do something and simply note what occurs. You may require him to weigh and measure the various materials which he uses for his experi-

ment, but if at the end of the experiment he does not have a final weighing and calculation he is not much more benefited than if he had been permitted simply to "dose out" his materials.

The past year we have had each beginner devote as much time to experiments of a quantitative character as of the purely phenomenal. Simple open-pan balances costing $8.75 and permitting weighing to a milligram have enabled our students to keep improving in exactness from day to day and see for themselves that they could become more expert.

Introduce plenty of simple mathematical calculations wherever possible, but always have them based on a weight experiment performed by yourself or the student. Do not murder the student's interest by giving him such problems as this to work: "What per cent of crystallized blue vitriol may be obtained from water cement of which 150 pounds have the capacity of making an iron bar placed in it weigh 250 grams heavier?" (Stammer's Chemical Problems, ex. 21, p. 54). How old was Ann? would be of more interest and fully as important.

Give variety to the work by performing yourself occasionally some experiment at the close of the period, announcing that the conclusions to be drawn from the experiment are to be discussed by the class at the next recitation. Never perform yourself nor have the student perform an experiment which has no scientific nor practical value, but is simply pretty. Lay emphasis on tests for elements and compounds from the beginning. A test for an element is simply one of its distinguishing characteristics and it can be well considered at the time the first study of the element is begun. Nothing is gained by postponing "tests" until qualitative analysis is reached. Always exhibit, if possible, the natural source of the element. A small collection of the more important minerals is of the greatest value for this purpose.

Chemistry cannot be "carried by assault"—like Port Arthur, it must be approached gradually and tunnelled into before even the outworks can be surmounted.

At one time with my classes I spent a good deal of time at the very first "studying the plans of the fortifications" by the use of text books. How we did study and recite definitions of the terms: Atom, molecule, atomic weight, and molecular weight. Using the word "Crith" frequently to help us out. These terms and definitions came first in the text book and so I thought must be first attacked and conquered. Had we any facts of our own derived from experiment from which to draw conclusions illustrating a need for these definitions? No, certainly not—but bye and bye we should need to use these terms, we were assured by the text book writer, and so loaded them in. I am not here today to oppose the use of a good text book by the beginner in chemistry, far from it. We beginners need all the help we can get, but at best a text book is only an aid. The object of chemical study should be "the thing" itself to know its properties at first hand, and the beginner becoming accustomed to experiment and reason for himself

is enabled to work out his own chemical salvation, ***assisted*** by the text book and teacher, but ***dominated*** by neither.

The best text book for the beginner is not one which tells him all about it, entering into the minutest detail, but rather the one which stimulates him to reason for himself and extend his knowledge beyond book-described experiments.

We cannot know it all. In Ostwald's Conversations on Chemistry (a dialogue which I recommend as being full of good things for instructors to ponder) the master says:

"M. Today we will learn more about oxygen.

"P. I know about it already.

"M. Only very superficially, for you only know a very small part of what is known about it, and what I am going to tell you is only a little part of what is known.

"P. But you know all about it.

"M. No, I do not think there is a single man who really knows all that is known about oxygen."

I have digressed too largely, perhaps, from my assigned topic, but I feel strongly that the good accomplished by chemical study is as much, if not more, due to the mental development and training afforded the beginner as to the greater familiarity with elementary substances and compounds with which he is brought into contact in the course of his study. Few of us who study chemistry ever make it a life specialty. The value of the work to the average student then must lie in the training which it gives and, if properly presented, the better view which he gains of his relation as a living individual to the universe of matter.

THE CHEMISTRY NOTE BOOK.

E. J. WILSON, ADRIAN.

The senses are the servants of the mind, they are the channels through which it obtains knowledge; if we were to cut them off, the mind, if it could exist at all, must do so in perpetual darkness. We understand and remember best, what we see and do. All knowledge is gained by sense impressions. In the laboratory knowledge is gained by means of all the senses; we see, hear, feel, taste, and smell,; handle, weigh, measure and compare. If properly conducted laboratory work is, therefore, excellent training, not alone in sense perception, but in logical thinking or reasoning as well.

If it be true, that knowledge is gained by means of the senses, how important it is that the senses be trained, so that they may furnish us with right impressions and thus lead us to form correct perceptions or ideas. A good course in laboratory work is the best sense training; it harmonizes the action of eye, hand and brain so that they work in unison.

Every idea tends to, and should find expression, either in a word or an act. Our pupils receive sense impressions and thus gain ideas in the laboratory. They also have an opportunity to give expression to some of these ideas in the manipulations required and of more of them directly to us in the laboratory, during the progress of the experiment, or later in the class room quiz. We cannot give every pupil an opportunity to express himself orally; and even if we could, the first crude expression needs clarifying, clothing in better English, and stating in a clear, simple way that means exactly what he wishes to express,—no more and no less,—thus the function of the laboratory note-book. The pupil here finds an opportunity to express the ideas obtained in the laboratory,—and not that alone,—but to compare certain facts, and by a process of reasoning, draw definite conclusions from related phenomena. It seems to me that this process of reasoning is of inestimable value. Man differs from the lower animals in that he has the power to think, to reason, and compare. Every exercise of mind which requires reasoning is, thus, an aid in lifting man above the brute; in raising him toward his proper sphere as a being that finds the greatest pleasure in the things which pertain to the mental life.

If the note-book is to serve this important office, that of a medium by which the pupil is to express and clarify his ideas,—and I believe the idea is not acceptably complete until it is expressed—how important that the data used, the facts stated, and the conclusions drawn shall be the pupil's very own. The order of the development of an idea is first, stimulus, second, sensation, third, comparison or association, fourth, idea. The senses are the avenues to the mind. The more vivid and varied the sense impressions, the more forcible the sensation; the clearer the ideas, and the longer they remain in consciousness. If, therefore, the pupil has not obtained his knowledge at first hand and thus received forcible and varied sense impressions, the ideas, if formed at all, are vague and soon drop into subconsciousness or are entirely forgotten. But are ideas formed? Do not pupils get words without ideas in many instances? The question is how can the note-book be made to best fill its important place in chemistry teaching? When and how and where shall it be written? When examined and how corrected by the instructor? What we want is not an ideal way which is not practicable, but the practicable way which most nearly approaches the ideal. In my judgment, the ideal way would be to require the student to write up all his notes, make his comparisons and draw his conclusions, independently in the laboratory, under the surveillance of the instructor; and not be allowed to carry his notes away with him to be completed; but be required to submit them for examination and correction before leaving the room. As soon as an experiment was completed and satisfactorily written up, the notes could be examined and returned to the student for future reference in reviews, laboratory work, etc.

While I believe the above to be the ideal way I do not consider it a practiceable way, in most high schools. The time given to laboratory work

is too short and can be better spent in becoming acquainted with nature at first hand, than in the analysis and correlation of results, making computations, and attention to the form of record. I do not mean that the pupil should keep no record of the results of an experiment at the time of making the observations; on the contrary, I believe that all results should be recorded at once,—but in a brief way, just enough being written to enable the pupil to recall later the phenomena witnessed in the laboratory. The pupil should, then, in the quiet of his study, make his final record of the experiment. This final record should be written with care and should show thought and discrimination; it should be the pupil's best effort in every way.

As to what should be put in the note-book, it seems to me that either of two plans may be followed. First, the student might be required to tell how he performed the experiment and state the results and conclusions in a connected way so that an examination of the note-book would reveal all the details. Second, he might be allowed to refer to the laboratory manual for manipulations and state results and conclusions only. The latter method takes much less of the pupil's time and shows equally well how the experiment was performed. The references to the manual can be easily made, if the directions are divided into lettered or numbered paragraphs. In case a paragraph contains simply directions for setting up the experiment, the number of the paragraph and the statement—I did as required—is sufficient. If a result is obtained, I believe it should be so stated as to include the conditions which produced it. The former method is the more complete; the more scientific; it is the research method and is to be preferred if time permits. Is it always to be preferred? I do not know.

It seems to me a waste of the pupil's time, to require him to copy lists of apparatus and materials from his laboratory outline. An appropriate diagram should be made; this, with a few words of explanation, will suffice, in many instances, to show how the experiment was performed, and is of value to the student. Many experiments require no diagrams,—those in which nothing but test tubes are used, for example. The lecture experiments, performed by the instructor, should be written up, accompanied by diagrams of the apparatus used, and bound together in a separate portion of the note-book.

I will now present, briefly, the method I am following and leave the subject with you for discussion, hoping that I may receive some helpful ideas from those of riper experience.

At the time of performing the experiment I require each pupil to fill out a data sheet. These are left with me at the close of the laboratory period and are made as brief as possible; just enough being written so that I am able to tell whether they performed the experiment correctly and saw what I wished them to see. I examine this rough record; designate portions to be repeated or indicates its acceptance by a suitable check; give the student credit in my laboratory record book, and return it the following day.

If any portion of the experiment is to be repeated, the student does so, makes the correction in his data sheet and returns it for criticism. When accepted, the experiment is written up on the detached leaves of a permanent note-book. These leaves, containing a record of the work completed during the preceding week, are handed in each Monday and are returned to the student within a few days. A record of relative merit, to be taken into consideration in making out monthly grades and final standings, can, conveniently, be made at the time of examining the notes.

Finally, allow me to state two reasons why I use this method. First, it saves the pupil's time in the laboratory; he is not trying to write elaborate notes while he should be observing or attending to the details of manipulation. Second, it enables the teacher to be reasonably certain that the pupil actually performed the experiment. Of course, we teachers of chemistry, who love the science, may find it difficult to understand why any person should try to avoid performing an experiment; still, we know that all minds are not constituted alike, and that it is somewhat difficult for some people to realize the importance of obtaining a knowledge of nature's laws by direct contact; it, therefore, behooves us to exercise care that one great object of the course in laboratory chemistry,—the acquisition of the scientific method,—be not thwarted.

QUANTITATIVE DETERMINATION OF THE STRENGTH OF AN ACID BY A WEIGHT AMOUNT OF SODIUM

M. A. COBB, LANSING, MICH.

It is difficult for the student to get a practical idea of the strength of an acid. I have found the following method helpful. I first saw the method used at the Michigan Agricultural College; it is also given in Clarke & Dennis' Laboratory Manual.

As illustrative of the method I shall try to determine the acid strength of vinegar. Fill a burette with acid, weigh a watch glass, cut and remove the coating from a piece of sodium the size of a small bean (.100 g to .175 g), weigh as soon as possible; put about 25 c.c. of distilled water in a test tube or tall beaker. Prof. Kedzie uses a beaker with a tube, the lower end in water.

Now drop the sodium on the water; after the action has ceased wash any adhering particles into the dish; add more water (100 c.c.) in using vinegar; titrate using phenol phthalein for the indicator in the case of vinegar.

The sodium will produce a definite amount of sodium hydroxid, which neutralizes a definite amount of acetic acid. From the known amount of sodium we are to calculate the amount of hydroxide produced and the amount

of acid this will neutralize. Dividing by the amount of acid used gives the amount in each cc. Tabulate as follows:

(1) Weight of sodium.

(2) Amount of sodium hydroxide produced: $Na + H_2O = NaHO + H$

23.05 gives 40.05
(1) " how much?

(3) Amount of acid neutralized: $NaHO + HC_2H_3O_2 = NaC_2H_3O_2 + H_2O$

40.05 neutralizes 60
(2) *g* neutralizes how much?

(4) Number of c.c. acid used.

(5) Amount of acid in each c.c. (3) ÷ (4).

(6) If the specific gravity of the acid varies much from 1 this may be found and the % acid calculated, (5) ÷ sp. gr. = — %.

The above experiment can be easily worked in any laboratory. Strong acid may be diluted until it takes at least 5 c.c of the acid for good results, The balance need not be necessarily very sensitive.

The method gives an easy and accurate way for determining the acid strength. This is a source of gratification to the student. It teaches the practical use of formulæ and strengthens his faith in them and gives the student some exact idea of acid strength.

As to the accuracy of the method I give results of several consécutive trials using H_2SO_4.

.04819
.04827
.04800

Another method gave for the same acid .04785.

ANALYSIS OF NITRIC ACID

B. W. PEET, MICHIGAN STATE NORMAL COLLEGE

Chemistry has to deal with the composition of things. Hence, any experiment that illustrates in a simple way the composition of the common chemical compounds is a valuable one for beginning students in chemistry.

Most texts take up the study of acids, bases and salts, and the composition of ammonia before the study of nitric acid, so the student is able to grasp the full meaning of the experiment as here given.

(a) Any solution that contains hydrogen ions will turn blue litmus red. Add a drop of nitric acid to a strip of blue litmus paper. It turns red—hence nitric acid contains hydrogen.

(b) Into a test-tube put 4 or 5 c.c. of water, add 10 or 12 drops of concentrated nitric acid and stand in the test-tube rack or an empty wide-

mouthed bottle. Add a piece of sodium hydroxide about twice as large as a good-sized pea and shake a few times; then add a few pieces of aluminium wire and if necessary heat over the Bunsen flame uitil the action of is quite vigorous. Test the odor of the escaping gas and note its action on moist red litmus paper. It is very evident that ammonia is liberated. When sodium hydroxide is placed on aluminium, hydrogen is liberated and the nascent hydrogen reduces the nitric acid, forming ammonia and water. The student already knows the composition of ammonia and can readily reason that the source of the nitrogen must be from the nitric acid.

(c) Place about a gram of coarsely powdered ferrous sulphide in a test-tube, cover with concentrated nitric acid, and heat a few minutes in a hood. Allow the solution to cool; dilute with two or three times its volume of distilled water; decant a portion of the dilute solution and test for the SO_4 ion by adding barium chloride. A heavy white precipitate of barium sulphate indicates the presence of the SO_4 ion. The student can readily reason out the source of the oxygen. The experiment thus shows nitric acid to be composed of hydrogen, nitrogen and oxygen.

QUANTITATIVE RELATIONS BETWEEN ACIDS, BASES AND SALTS—THE PREPARATION OF PRIMARY AND SECONDARY SALTS OF SULPHURIC ACID

R. R. PUTNAM, EASTERN HIGH SCHOOL, DETROIT

There seems to be little call for a lengthy report upon this subject just now. The main part of the matter was so thoroughly covered by Mr. Irwin last year that there is little to be said. In his report he described experimental work that has been successfully presented for several years. This work covers the ground well, and I do not at present see that it can be much improved upon.

The works is as follows:—Normal solutions of caustic soda and caustic potash and of sulphuric, hydrochloric and nitric acids are provided. From these each pupil prepares about half a liter of decinormal strength. The basic solutions are then titrated against the acids, using phenolphthalein as indicator. For this purpose two burettes may be used, though, probably, it is as well to use one burette and a pipette, as the results are just as satisfactory, and the pupil gets some practice in the use of the latter instrument. The following calculations should be made from the experiments: (*a*) The number of gram-equivalents of each base required to neutralize a gram-equivalent of each acid. (*b*) The number of gram-equivalents of each acid required to neutralize each base. (*c*) The number of gram-equivalents of the bases of equal neutralizing power. Finally equations for each reaction

may be written, and the numbers given by the above calculations compared with those expressed by the equations. It might be a good plan to introduce one or two "unknowns" at this point. For this purpose solutions of any of the above bases or acids of about semi-normal strength may be given out. The percentage of the base or of acid may be determined by titration and calculation. The pupil can, in this way, easily get hold of the principles of simple volumetric analysis, and the methods of calculating the results of such analyses. It will probably be best to weigh a measured volume of the liquid, and then titrate an aliquot part of this in the ordinary way.

The two sulphates of sodium, for example, may be prepared from the same normal solutions as are used in the above work. Measure out 25 c.c. of normal sodium hydroxide into each of two beakers. Neutralize the contents of one beaker exactly with normal sulphuric acid, using litmus paper as indicator. The contents of the second beaker are likewise exactly neutralized with normal sulphuric acid, the volume of the latter being noted. Then an equal volume of normal sulphuric acid is added. The contents of both beakers are evaporated to crystallization, and the products compared as to solubility, taste, reaction to litmus, melting point and action upon magnesium. The same experiment may be repeated, in all its detail, using normal hydrochloric acid in place of normal sulphuric. The results in the first case are, of course, primary and secondary sulphates of sodium, in the second, common salt. These experiments should serve to open up the question of acid and normal salts, and should show, in some small degree, how the question can be settled. They also have a bearing upon the formula of hydrochloric acid. The results of the experiments, naturally, cannot be taken as *proofs* of anything excepting the fact that we do have two sulphates of sodium, one of which contains hydrogen, and the fact that, *by this method*, we cannot produce two chlorides of sodium. This result in the pupil's mind is much better than that arising from the course of reasoning carried out in too many class rooms and text-books:—"The molecule of sulphuric acid contains *two* replaceable atoms of hydrogen, therefore, we have two sulphates of sodium; the molecule of hydrochloric acid, on the other hand, contains but one replaceable hydrogen atom, hence we can have but one chloride of sodium."

And now, having, rather vaguely, I fear, answered certain questions, I may be pardoned if I ask one or two on my own account. How much, and what theory shall we put into our work? How much atomic hypothesis? What shall we do about valence? How much equation writing shall we attempt? How far is it wise to carry our drill on formula writing? Is it a good plan to make such general statements as, for example, "All common metallic hydroxides excepting those of the alkalie and alkaline earth metals are insoluble in water, the latter slightly so," and then make such general statements the basis of specific statements as to the method of preparing particular compounds? What is the place of the electrolytic dissociation

theory in secondary instruction in chemistry? I hope that this section of the Schoolmasters' Club can take up such questions as these in the near future, and approve some plan of teaching.

THE VOLUMETRIC COMPOSITION OF WATER VAPOR.*

PROFESSOR GEORGE A. HULETT, UNIVERSITY OF MICHIGAN.

The volumetric relations of interacting gases and vapors are of fundamental importance in our atomic and molecular theories, and Hoffmann has done a very considerable service in devising many experiments to demonstrate these fundamental facts. But the experiment as commonly performed to show the volumetric composition of water vapor is difficult to carry out and most frequently fails as water vapor is very liable to appear in the eudiometer tube when steam is passed through the jacket, and then it is necessary to dismantle the apparatus before another trial. This and other difficulties frequently necessitate postponing the experiment and discussion until the next lecture.

I have used, for several years, an apparatus that gives very satisfactory results, and have been asked to describe the experiment. The apparatus allows one to repeat the experiment without dismantling or even stopping the steam in the heating jacket, and has the advantage of an adjustable mercury reservoir, which is joined by a rubber tube to the straight eudeometer tube. The essential feature of the method is a capillary tube sealed to the top of the eudeometer tube and extending outside the steam jacket. Water vapor can be removed through this tube, so it is not necessary to dry the mercury or tube before setting up the apparatus. The detonating gas mixture (2 vol. H, and 1 vol. O,) is also introduced through this capillary and then the capillary is filled with mercury, closing it at the point where it is sealed onto the eudeometer tube and inside the steam jacket.

The accompanying figure gives a drawing of the essential parts of the apparatus. (L L) is a glass jacket some 5x60 cm. closed with split corks, which bear the graduated endeometer tube (C D) 1½x65 cm. This tube is provided at (C) with the usual platinum wires and well insulated leads which are joined to a Rhumkorff coil for exploding the gas mixture. At C is sealed in a capillary (1 mm. bore) tube, 12 cm. long and ending in the two-way cock, B. This cock B communicates with the little mercury reservoir A or through the tube (F) to the exit (I) or down to the detonating gas generator K, depending on the position of the three-way cock (E). K, the detonating gas generator, is some 2½x15 cm., provided with small platinum

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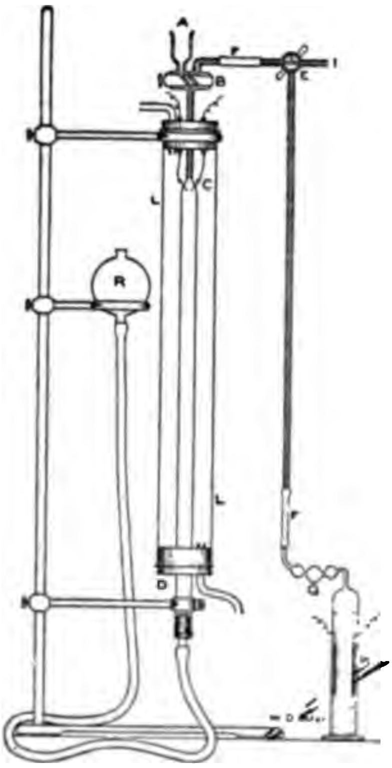
*A lecture experiment.

electrodes; the generator is provided at G with sulphuric acid drying bulbs; at (F F) are rubber joints to make the apparatus flexible. (With a little skill in glass blowing we can make a very cheap generator from a glass tubing, leaving the bottom of the generator open for a cork which carries two nickel electrodes). It is best to use a 15% solution of caustic soda or caustic potash in the generator, to avoid the formation of ozone. An ampere current will yield about 12 c.c. of detonating gas per minute and about 4 volts is necessary



for this purpose with the above generator. A convenient switch is needed in the battery circuit to make and break the generating current at will. The generator must be allowed to run long enough to remove all air from the generator, dryer, etc., through the cock (E) and exit (I). R is an adjustable mercury reservoir held in a three-quarter ring which allows of its being removed for rapid lowering and raising. The jacket is heated by steam from a large flask of boiling water. The exit is below and if other vapors than steam are used for higher temperature a condenser is attached to the lower outlet.

After the apparatus is set up and steam begins to pass through the jacket, water vapor may appear in the endeometer tube. To remove this

the cocks B and E are turned so as to communicate with the exit (I), and by raising and lowering the reservoir several times the vapor is swept out by the air that is drawn in and forced out. The generator is now started and the cock E turned to bring the gases into the apparatus. After some of the gases have been introduced into the endeometer tube it is well to turn the cock E and force them out through I and then fill for the experiment. When the desired volume of detonating gas is introduced, the battery circuit is broken and the cock B is turned to communicate with the little reservoir A filling the capillary with mercury and closing the endeometer tube off at C. The cock B is then closed. The volume of detonating gas is measured and after lowering the reservoir to rarify the gases they are exploded, and the resulting volume of vapor measured. The experiment can be repeated in a very short time, first removing the vapor as above described. The lead wires must be well insulated and insure a spark at the platinum points. It is well to have one at least pass through a small glass tube in the upper cork. If steam is used in the jacket it will be necessary to measure the vapor formed under diminishing pressure, for the water vapor deviates considerably from the gas laws at the boiling point of water; one can easily measure all volumes under diminished pressure by keeping the reservoir a definite, measured, distance below the mercury in the endeometer tube by using a short measuring stick. If it is considered more desirable to measure the gases and vapor at atmospheric pressure, one may use amyl alcohol, giving a temperature of about 130°, and then a condenser is to be used for the outlet. With a little skill in glass blowing we can easily construct the above apparatus as the cocks used are commonly at hand. Such an apparatus was exhibited at the last meeting of the Michigan Schoolmasters' Club, and gave as a result 20.8 c.c. detonating gas and 14.05 water vapor, and many of the results are even better than this.

A SIMPLE EXPERIMENT TO DETERMINE THE VOLUMETRIC COMPOSITION OF AMMONIA.

LINUS S. PARMELEE, FLINT.

By the use of very simple apparatus it is possible to determine the volumes of hydrogen and nitrogen in ammonia.

This is an experiment that the student can perform successfully and comprehend thoroughly.

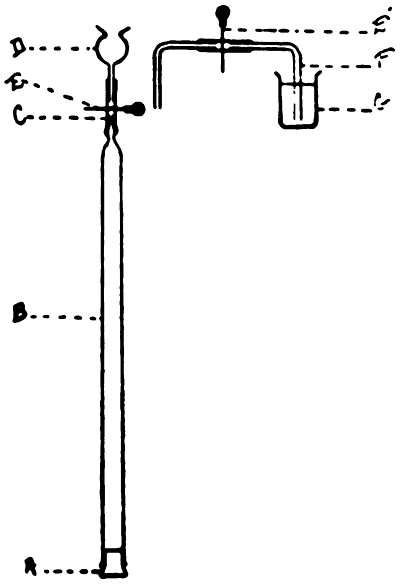
Almost any kind of a tube can be used; plain tubing, gas tube, burette or Hoffmann tube. A tube fitted with a glass stop-cock is preferable.

The tube (B) used for this experiment is a plain burette fitted with a rubber stopper (A) at the large end (P) and a short piece of rubber tubing (C) with pinch clamp (E) at the other end.

From a small chlorine generator that has been running at least ten minutes fill the tube by displacement of water. When full pinch the clamp an instant and let the increased pressure of the gas drive the few drops of water up through the rubber tube.

Allow the tube to stand in the trough till the water runs down the sides, finally adding chlorine, if necessary, to fill it.

Close the open end with the stopper (A) pushed firmly in, and again slightly pinch the clamp. (Do not warm the gas by handling the tube).



Clamp the tube vertically in a support and insert a short stemmed thistle tube (D) in the rubber tube at the top. Pour 10 cm^3 of strong ammonium hydroxide in the thistle tube and work a glass rod up and down in the stem to remove air bubbles.

Measure the length of the chlorine column, making a previously determined allowance for the small end.

Let the ammonia drop slowly into the chlorine till nearly all is used. Remove the thistle tube and tilt the burette so that the ammonia surely uses up the chlorine.

Connect the burette with a beaker (G) of dilute sulphuric acid (1 to 4) by means of a tube filled with water (F). [A convenient form is shown in the diagram. Remove E^1]. Remove the clamp (E) and allow the pressure to equalize. Let the apparatus stand till the remaining gas is of room temperature.

Measure the length of the new gas column.

Test the gas for, odor, color, combustion. What is it?

What have you previously learned concerning the volumes of hydrogen and chlorine that unite?

The hydrogen of the ammonia (NH_3) united with the chlorine. What volume then of hydrogen was used? What became of the nitrogen originally with this hydrogen?

What is the volumetric composition of ammonia?

The actual volumes of chlorine and nitrogen can be determined by measuring the water the tube holds and the volume of the resulting liquid, and subtracting. However, if the tube has a uniform bore the comparison of the lengths of the columns is much simpler and more satisfactory.

A SIMPLE RESONATOR.

M. A. COBB, LANSING, MICH.

A short time ago I noticed the similarity between a Helmholtz resonator and an incandescent light bulb. Acting upon this observation I broke the tip of a bulb and enlarged the opening by means of a file and punched in the cavity carrying the wires.

Holding the small orifice to the ear and the other towards the source of sound as the key board of a piano the air resounds—that is, the sound is louder when its natural period of vibration is struck. "Phonograph tubes may be used to transmit sound to the ear.

The bulb is similar to a Helmholtz resonator and its action is familiar to you.

The ordinary size, 16 c p bulb, with a small opening, responds to about 256 vibrations. As the bulb becomes larger the pitch lowers and vice versa. Here is a 294 c c bulb, the note is c; a 167 c c, the note is e.

As the area of the orifice becomes larger the note is higher; the note of a bulb can be changed by enlarging the orifice.

There appears to be no simple relation between volume or area to the pitch. Londhauss gives the formulæ for circular and flask with a neck as:

$$N = 52400 \sqrt[4]{\frac{\text{area}}{\text{Vol.}^2}}$$

$$N = 46705 \sqrt{\frac{\text{area}}{8 \text{ Vol.}}}$$

I found the constant to be much lower, but with the means at my command could not get check or reliable results.

The bulbs can be used for resonators for analysis of sound and deter-

mining the characteristics of quality. For instance, I found a bulb to resound strong for middle "c," weak for c, and faint for g, proving that the latter strings of the piano were vibrating in two or three parts respectively.

Interference of waves at the edges of a tuning fork can be clearly demonstrated by holding the bulb in various positions and using the phonograph tubes.

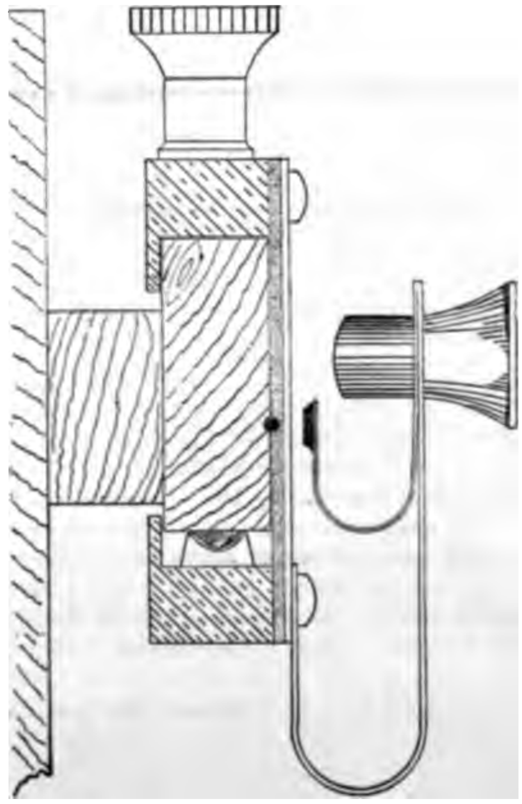
I have fair results in determining the vibration rate of a note by means of the siren, noting when the siren and a resonator were in unison.

The resonators show clearly that confined air has a vibration rate of its own and vibrate freely when the vibrating body is of the same rate.

A CONTACT KEY FOR A SLIDE WIRE BRIDGE.

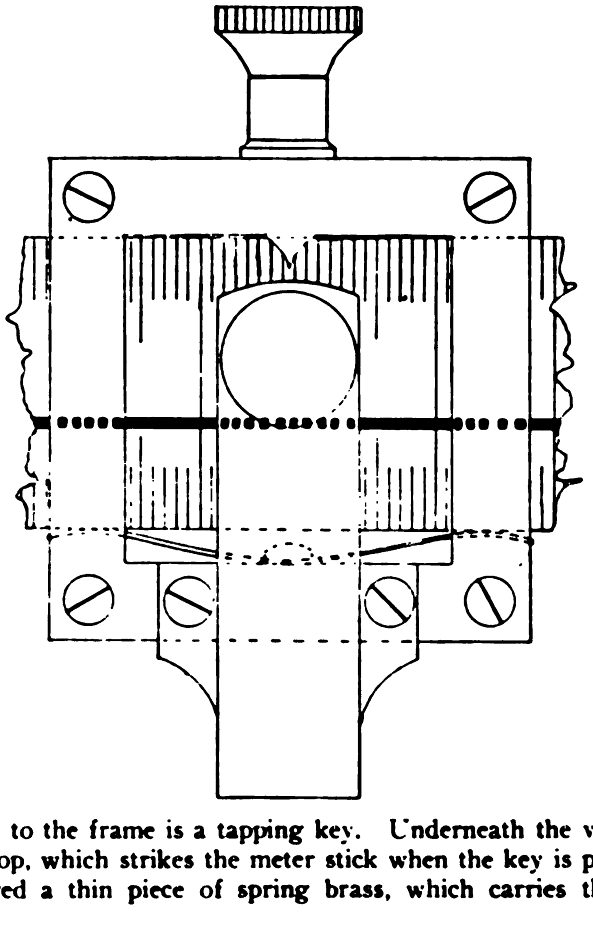
H. L. CURTIS, MICHIGAN AGRICULTURAL COLLEGE.

In designing a contact key for a slide wire bridge the following things need to be considered. It should be possible to operate the key easily. The electrical contact within the key should be good. Either the zero point or the point of contact should be adjustable, so that the two may be brought into coincidence, yet when once adjusted there should be no danger of either



of them changing. It should not be possible to apply undue pressure on the point of contact. A key which answers all of these requirements except the last, is described in Price's "Measurement of Electrical Resistance."

The key about to be described is very similar to this, but has an added feature to overcome this defect. The key is illustrated in the drawing. It slides on a meter stick which is raised a short distance from the base of the bridge. A piece of insulating material (wood fiber is cheap and satisfactory), prevents the wire from touching the metal above. Also because of the wire sliding in grooves, it will always be underneath the platinum point, so that contact is certain when the key is pressed.



Fastened to the frame is a tapping key. Underneath the vulcanite top of this is a stop, which strikes the meter stick when the key is pressed. To this is soldered a thin piece of spring brass, which carries the platinum contact.

The contact point may be made to coincide with the pointer by moving the tapping key in slots (not shown in the drawing) where this is fastened to the frame.

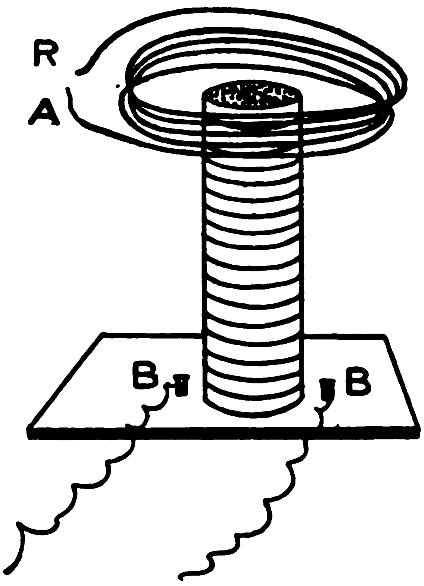
This key has been used for two terms, and has given very satisfactory results.

A SIMPLE STEP-UP AND STEP-DOWN APPARATUS.

DE FORREST ROSS, YPSILANTI.

The above heading, though not a misnomer, covers only a part of the possibilities of this simple and inexpensive apparatus. As many of the high schools are now equipped with the alternating current for lighting purposes, it occurred to me that this current might be used for demonstration work in the physical laboratory. The electro magnet before you is the outgrowth of that idea, suggested by some experiments of Professor Carhart at one of our physical conferences.

First, then, is to make the magnet, as, so far, I have been unable to find anything in the market that will answer the purpose. Procure of your



hardware dealer twenty to twenty-five pounds of No. 16 annealed iron wire, and cut it into pieces about fifteen inches long. Bind these in a compact bundle with electric wire tape, and make the top level by driving the wires down with a hammer. This will constitute the core of the magnet. Fasten the core to the base in an unright position by cutting a hole in a board just large enough to admit the end of the core. Bend enough of the wires over around the outer edge to hold the core firmly in position and fasten them to the under side of the board with staples. Then by driving wedges between the wires, the core can be made to stand rigidly in its place. Nail another board on the under side to cover up the uneven ends of the core and it is ready for winding.

Begin at the bottom and wind in smooth, close coils four layers of No. 12, double covered copper wire, to within one inch of the top and fasten the ends to binding posts in base. The whole coil should now be covered with electric tape.

Several coils of well insulated copper wire should be made, varying in size of wire, diameter of coils, and number of turns in each. These should be fastened with tape for convenience in handling, leaving the ends long enough for connections.

With a coil of fifty or sixty turns of No. 12 copper wire wound so as to fit rather loosely the primary coil, the terminals connected by a No. 16 copper wire, and the coil lowered to the centre of the magnet, an induced current will be produced strong enough to quickly fuse the wire and cause the copper to boil like water. Iron wire between the terminals will burn with brilliant scintillations. The operation, however, can hold the naked terminals in his hand without feeling the slightest effects of the current. This illustrates in a forcible way a step-down device.

If a coil of five hundred or six hundred turns of No. 20 wire be used, the potential becomes so high that it will make an electric lamp glow intensely, and by attaching handles to the terminals and slowly lowering the coil from some distance above the magnet, a range of physiological effects will be experienced, varying from an almost imperceptible pulsation to that of sufficient strength to satisfy the most ardent. These are only suggestions of things one can work out, once started along this interesting line. You will also be surprised to see the interest your students will take and how much they will get from this, to them, most difficult part of electricity.

CONSERVATION OF ENERGY WITHIN THE HUMAN BODY.

ARTHUR W. SMITH, PH.D., UNIVERSITY OF MICHIGAN.

The nutrition of the human body is a subject of great importance to every one of us. Whether we realize it or not, it is presented to us three times a day, and more or less wisely we attempt to reach a satisfactory solution of the problem. The question has also been attacked from the scientific standpoint by a number of investigators, and in the brief time at my disposal I want to give you the results of some experiments along this line.

In so far as the material phenomena are concerned, life consists of transformations of matter and energy. It is commonly assumed that these transformations follow the laws of the conservation of matter and the conservation of energy, although the experimental proof that they do has been lacking. In order to show that the law of the conservation of energy holds true in the body one must be able to measure the energy received

from the food, the energy expended as muscular exertion, that given off in the form of heat, and the loss or gain in the store of energy in the body. This last is the most difficult factor to determine. If the body is warmer at the end of an experiment than at the beginning, or if it has a larger store of fat, it has gained energy. On the other hand, if its store of fat has decreased or its temperature is less, it has lost energy. If then it can be shown that the total energy received by the body just equals the total energy expended, plus or minus the gain or loss in the store of energy, it would be a direct confirmation that the law of the conservation of energy holds in the living organism.

A number of investigators have experimented along this line. Most of them have studied the balance of carbon, or nitrogen, or both. About 1892 Professors Atwater and Rosa began an investigation which has demonstrated that not only did the law of the conservation of matter hold true, but also that the income and outgo of energy balanced as well. The investigation, which is still in progress, is a most difficult and intricate one, requiring untold labor and infinite care for details. The work has received generous aid from Wesleyan University, Storrs Experiment Station, Congress and the Carnegie Institution. A number of skilled investigators have been busy for a dozen years and are still at work. Much valuable information regarding the nutrition of man has been obtained, and a full account of the work would fill many volumes. The most interesting phase of the investigation, however, is the light it throws on the purely scientific question of the conservation of energy.

The apparatus consists of a chamber, 4 ft. by 7 ft. by 6 ft. high, in which the subject of the experiment lives, eats, drinks, sleeps and works, during a period of several days and nights. An abundant supply of fresh air is constantly supplied, and there are arrangements for keeping the chamber at a constant temperature. The heat given off from the body of the man in the chamber is carried away by a current of cold water, which passes through a series of pipes inside the chamber. By properly regulating the temperature of this water and also its rate of flow, it is possible to maintain a constant temperature within the chamber. When this is the case the heat is being carried away just as fast as it is generated. The heat thus removed is easily determined, knowing the amount of water and its increase in temperature.

In order that the heat, thus carried away from the chamber, shall exactly represent the amount given off by the man within, it is of course necessary that no heat shall enter or leave the chamber through its walls or by the ventilating current of air, and due care has been observed that such is the case. Since a man eats and drinks a large amount of liquid water and gives it off in the form of vapor, quite a large amount of heat is required to vaporize it, and this heat must be added to that measured directly by the calorimeter.

Before commencing actual experiments with men it was necessary to

test the accuracy of the apparatus as a calorimeter. For this purpose two kinds of tests were employed. In the first a known amount of heat was produced within the chamber by passing an electric current through a coil of wire, this heat being absorbed by the current of cold water, carried away and measured as described above. The second form of the tests corresponds much more closely to the actual case of a man. An alcohol lamp within the chamber burns a weighed amount of alcohol. This produces heat, water vapor and carbon dioxid, which quantities are in turn measured by the apparatus. The results of these tests are given in the table below, and show that the calorimeter is as accurate as could be hoped for.

The experiments with men have been of two kinds. Rest experiments in which the man did as little muscular exertion as was consistent with comfort; and work experiments, in which he did as large an amount of work as possible for eight hours each day. During the four days preceding an experiment the man eats, sleeps and works just as he expects to do within the chamber. On the evening of the fourth day he enters the chamber and is sealed in. The next morning everything is in readiness for the observations to begin, and the experiment may run from two days to fourteen days.

SUMMARY OF EXPERIMENTS

	NUMBER OF EXPERI-MENTS	DURATION	INCOME	OUTGO	PER CENT CALORIES
TEST EXPERIMENTS			CAL.	CAL.	
Electrical	5	37 hrs.	3016.3	3016.7	100.01
Alcohol	9	317 hrs.	41703.	41676.	99.93
WITH MEN			CALORIES PER DAY		
Rest Experiments	13	45 days	2255	2250	99.8
Work "	6	20 "	3669	3656	99.6
All "	30	93 "	2719	2716	99.9

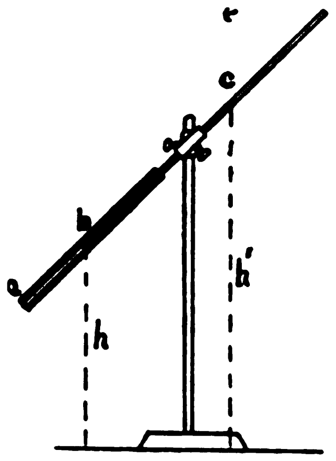
The final results of a large number of experiments are given in the table. In the work experiments the conditions are the most unfavorable for exact results, and all of the experiments are subject to some error, more or less; but since some of the errors will be one way and some the other, the average of a large number will be much nearer the truth than any one. Averaging all of the experiments with men it is seen that the income and outgo of energy balance each other to within the limits of error of the apparatus, that is, to within a small fraction of one per cent. It is therefore safe to say, that, within this small amount, the law of the conservation of energy holds true within the human organism.

MELDE'S APPARATUS FOR BOYLE'S LAW.

C. S. COOKE, CENTRAL HIGH SCHOOL, DETROIT.

In the Report of the Physics Conference for 1899 is described a capillary barometer, and the suggestion was made that the device could be used for verifying Boyle's Law. Just why this feature of the apparatus has never been exploited by some member of the Conference is not apparent. The writer finds that the apparatus herein described is already in use in some high schools, consequently he does not presume to present anything new.

The apparatus needs very little description. A barometer tube about one meter long and 1.5 mm. in diameter is thoroughly cleaned with a solution of bichromate of potash and sulphuric acid. This cleansing solution is



Boyle's Law Apparatus.

followed by distilled water, and finally alcohol is used as a dryer. One end of the tube is carefully sealed in the flame and if only the very end of the tube is heated, it will be sealed nearly square across. The tube is then placed in a suitable clamp and brought to an inclined position of about 45°. An iron wire with about one-quarter of an inch of its end doubled firmly back on itself, is pushed into the tube to about 25 cm. from the closed end. Mercury is then poured through a finely drawn out thistle tube so as to form a column about 30 or 40 cm. long. If the enclosed air column is too long, air can be removed by pushing the wire a little further into the tube. The usual readings for pressure and volume are taken with the tube first in a vertical position and then shifted about 20° each time until the tube is inverted. A paper scale pasted on the tube is used to obtain readings of the

volume, and a meter stick fastened in a vertical position to a suitable base will serve for measurements of the height of mercury column. The table needs to be perfectly level.

a	b	h	h'	h'-h	P	V	P x V
50.00 cm.	61.46 cm.	15.93 cm.	57.28 cm.	41.35 cm.	117.35 cm.	11.46 cm.	1345.
" "	61.65 "	18.00 "	57.55 "	39.55 "	115.55 "	11.65 "	1346.
" "	62.55 "	26.25 "	57.25 "	31.00 "	107.00 "	12.55 "	1343.
" "	64.23 "	37.60 "	56.00 "	18.40 "	94.40 "	14.23 "	1343.
" "	65.70 "	44.70 "	54.50 "	9.80 "	85.80 "	15.70 "	1347.
" "	67.67 "	51.85 "	52.13 "	.28 "	76.28 "	17.67 "	1348.
" "	69.50 "	56.45 "	49.70 "	- 6.75 "	69.25 "	19.50 "	1350.
" "	72.00 "	60.60 "	46.05 "	-14.55 "	61.45 "	22.00 "	1342.
" "	75.20 "	63.50 "	41.00 "	-22.50 "	53.50 "	25.20 "	1347.
" "	79.00 "	64.20 "	34.80 "	-29.40 "	46.60 "	29.00 "	1351.
" "	83.90 "	62.58 "	26.40 "	-36.18 "	39.72 "	33.90 "	1346.
" "	88.85 "	60.40 "	19.23 "	-41.17 "	34.83 "	38.85 "	1353.

The only comment the writer has to make is that the apparatus is exceedingly simple, requires very little mercury, and is easily understood and operated by the pupil. If the tube is carefully selected, there will be no appreciable error due to lack of uniformity of bore. Our pupils readily get results within 1% variation.

COEFFICIENT OF EXPANSION OF AIR UNDER CONSTANT PRESSURE.

E. A. CLEMANS, CENTRAL HIGH SCHOOL, DETROIT.

A few years ago, Mr. N. H. Williams, then of Detroit, presented before this Conference a coefficient of expansion apparatus wherein he used sulphuric acid as a leveling liquid and thus insured the dryness of the enclosed volume of air.

By borrowing this idea and combining it with a modified form of the apparatus described in the preceding paper, we have an efficient means for determining the coefficient of expansion of air under constant pressure.

This apparatus has four qualities that appeal to the physics teacher. It is easy to make, is durable, is simple to operate, and is fairly accurate.

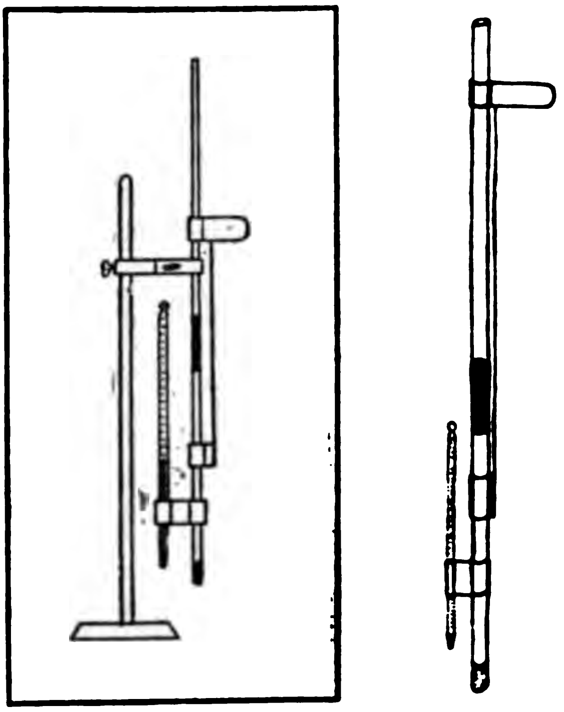
It consists of a capillary tube about two feet long sealed at one end and containing at the closed end a small quantity of sulphuric acid. At about its middle, the tube holds a short thread of mercury. If held in an upright position, the air enclosed between the mercury and the acid will be under a pressure of the atmosphere plus the weight of the thread of mercury and for short periods this may be considered constant.

The volume of the air will then be affected by temperature changes only and the volume at different temperatures may be read in units of length of

the tube. To facilitate this reading I placed on the tube a brass sleeve, fitting just tightly enough so that it could be moved along with a little effort. The position of this sleeve is adjusted by means of a brass rod soldered to it and guided at its upper end by a similar sleeve.

Having placed the tube in a cylinder of water, the edge of the lower sleeve is brought even with the end of the mercury column, the temperature of the water is taken, and the apparatus is removed from the cylinder and clamped in front of a mirrored scale.

The volume of the air is then read. The pupil will adjust the sleeve much more quickly and accurately than he would take a reading. He may



then turn his attention to the reading of the temperature, reading the volume at his leisure and under favorable conditions. A brass bracket may be attached to the tube for holding a thermometer securely and in the immediate neighborhood of the enclosed air.

To get the sulphuric acid to the bottom of the capillary tube, I made a funnel with a long slender tube by heating a piece of large thick glass tubing and drawing it out quickly.

Following is a set of data taken by an advanced student:

TRIAL	TEMPERATURE	VOLUME	INCREASE IN VOLUME	INCREASE PER DEGREE	COEFFICIENT
1	0.	15.80	......	......	....
2	10.	16.38	.58	.0580	.00367
3	19.	16.90	1.1	.0579	.00366
4	53.8	18.88	3.08	.0572	.00362
5	66.	19.58	3.78	.0573	.00363
6	71.3	19.92	4.12	.0579	.00366
7	81.	20.55	4.75	.0586	.00371

REPORT OF THE COMMITTEE ON MATHEMATICS AND PHYSICS.

CHARLES W. BURROWS, CENTRAL HIGH SCHOOL, DETROIT.

The purpose of this report is to call attention to the relations of mathematics to physics, to point out places where these relations are strained, or out of adjustment, and to suggest remedies for whatever evils may exist. It is generally admitted as far as physics and mathematics are concerned, mathematics is the tool and means of attack on a large portion of the problems of physics. If the student is not well grounded and skilful in the use of these tools, his progress is much hampered and the work of science advances under a great handicap. I need not spend much time in proving the proposition that the mathematical training has not produced all that the physicist could desire.

Most of the criticism to which mathematics is open is due to the fact that our work is superficial, not superficial in the sense that each subject is not taught thoroughly, but because it is not taught in its proper relation to life. It appears as an isolated mathematical idea connected by a slender thread to what has preceded and by a still more slender tie to what is to follow in a certain mathematical sequence, but of no moment in the problems of the world. It would be desirable if no new subject were taken up until there was a demand for it, not until it was obvious that the innovation was for the purpose of saving labor or lengthening the intellectual arm so that it might grapple with new problems. Let the pupil feel that new subjects and new methods are as useful in extending his vision in the realm of mathematics as the telescope and microscope have been in other fields of nature. Let him feel that mathematics is the science that puts him in touch with the quantitative in nature, that it is a part of nature itself. If we can do this we have the element of interest on our side, and without this essential we labor in vain as far as any permanent good results are concerned.

To exemplify this idea let us consider the mental condition of our pupils just before they start the study of algebra. The problems of arith-

metic are difficult and if we analyze the difficulty we see that there is in the problem an intangible something which is constantly eluding the pupil. The intangible is freed from this elusiveness as soon as we give it a name, and with the representation of the unknown quantity by X we have made an advance which is obvious to the tyro and as essential to success as was the insertion of the symbol zero in our number system. With this addition and the use of the equation which logically goes with it our pupil finds himself gifted with new powers. Let these powers be exercised on practical problems of increasing difficulty. Let him see by induction that while there are countless problems that may be given him, yet this number may be reduced very materially by a little generalization. He is thus led to the solution of literal equations. In the interpretation of these latter he becomes acquainted with certain formulæ and their values in certain definite numerical problems. If he can transform and substitute in simple literal formula he has about the algebraic facility that is required of the average practical man. The average high school graduate, however, can not use this much mathematics. As soon as this much is understood and before he has a chance to make it a part of himself, he is ushered into new subjects, and these in turn are replaced by others. He completes his course with a certain amount of general training due to his mathematics, but with as little facility in the application of his theories to practical problems as a man who had studied various books on the art of swimming and even had practiced on the floor of his bedroom, would have in breasting the turbulent wave.

In geometry a reasonable amount of intuition might be assumed, *e. g.*, assume "All right angles are equal;" also "If two adjacent angles have their exterior sides in the same straight line, their sum is equal to two right angles," and some other propositions equally as obvious to the student. It is also desirable that the reality of geometry be made evident. Quite often we feel that the mental discipline is not only the main but also the only benefit to be derived from the study of geometry. We lose sight of its vital relations and are satisfied with the beauty of its logic. One pupil who always stood at the head of her class told me she thought geometry was delightful. "You start," said she, "with a few axioms and definitions and build up day by day a glorious structure. Each proposition is a direct result of all that preceded, and you wonder where it all is going to lead eventually." This is, I think, the prevalent view of our best sudents. Geometry is to them as religion is to many people, a thing of the intellect concerned with the future but of no material connection with the affairs of today.

Pure mathematics is an exact science, but applied mathematics deals with approximations. Our students lose sight of this. For instance in getting the circumference of a circle the value $\pi = 3.1416$ is almost invariable used, even though the data may be in error 1%. Results thus obtained are misleading. They should be taught the effect of an error in certain quantities, and taught it early, not in their second year of university work

as at present. It would not be hard to show them that $\pi = 3$ is only 3% out of the way, and $\pi = 3.1$ is 1%, while $\pi = 22/7$ is only 1/30% in error. The value $\pi = 3.1416$ is in error by only .002%, a degree of accuracy realized by no instrument known to me. Then why have our pupils use this value?

Another case that shows lack of feeling for number is the averaging of a column of values nearly equal, as,

24.7
24.4
24.6
24.5
24.7
24.5

The majority will add all three figures of each number and not notice that the variation is in the last figure alone. Further, in such an example as the above it is not unusual to have an average reported which is beyond the range of the given values. The pupil does not feel the relation between the average and the individual numbers.

Again, in multiplication and division results are obtained, in which a misplaced decimal point makes the final result of an order of magnitude quite different from what we know it to be. Such things as these should appear as incongruous to the pupil as would a man in midsummer heavily muffled in furs. I have said nothing about division by 10 by the long method, or multiplication by 12 in two steps, but have cited just a few cases to show that quantitative relations are vague to the average student.

One criticism I make against the problems commonly found in our modern text-books is the lack of reality. I shall cite just a few. Here is one taken from a leading text-book of algebra. "A shepherd has a number of sheep such that 4 times the number minus 7 is greater than 6 times the number minus 89, and 5 times the number plus 3 is greater than twice the number plus 114. How many sheep has he?" It is hard to show the student that this problem has any application other than to keep him busy. Here is another impracticable one in the form of an equation:

$$\sqrt{a \div x} + \sqrt{a - x} = \sqrt{x}.$$

The answers given by the author and obtained in the regular way are 0 and 4a/5, both of these roots are extraneous, as is easily seen yet nothing is said about this. Such problems as these, and they are not rare, tend to shake what little confidence our pupils may have in either the utility or the reliability of mathematics.

This report would be incomplete without a few comments on the laboratory method. Let me translate a paragraph written by Laisant in his work La Mathématique: "All science is experimental. Nothing enters our understanding without having passed under the view of our perceptions. Mathematics no more than any other science can escape this common law. I believe that without the presence of the external world no mathematical knowledge could ever penetrate the brain of man, and that

in a universe reduced to the condition of pure intelligence, the most incomparable genius, whether it be an Archimedes, a Gauss, or a Lagrange could never arrive at the conception of the number two."

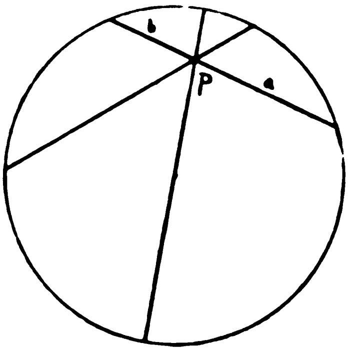
While we all regret that laboratory work of some kind is desirable, there is considerable doubt as to what to include. I wish right here to register a protest against setting up a preliminary physical laboratory and calling it mathematics. This only makes matters worse for the physics. It robs the physics of its charm of novelty and does not overcome the mathematical difficulties. What we need is an opportunity to verify and investigate the truths relating to magnitudes, and to attain facility in the use of mathematical instruments whether they be mental or mechanical, just as in the physical laboratory we verify and investigate physical laws and aim to attain facility in the use of physical instruments. Since the work of the mathematical laboratory would deal with lengths, areas, and volumes, as well as pure numbers, it might well contain most of the following pieces of apparatus. I merely enumerate them without taking time for comment:

- Measurements of lengths.
  - 2-foot rule
  - yard stick
  - 50-foot tape
  - vernier calipers
  - micrometer guage
  - chartometer
- Measure of area.
  - section paper
  - planimeter
- Measure of volume.
  - U. S. liquor measure
  - metric set
- Measure of angles.
  - protractors
  - scale of chords
  - engineer's transit
  - architect's level
  - spherometer
- Aids to computation.
  - slide rule
  - carpenter's square
  - mathematical sector
  - mathematical tables
- Miscellaneous.
  - scale rule
  - proportional dividers
  - drawing set
  - plans of buildings

Much of the work that is done in arithmetic could be done as laboratory working algebra. Pains should be taken here to make the work practical. When the theory of exponents is taken up is a good time to introduce the use of logarithms and the slide rule in elementary calculations. They are both so closely connected with the theory of exponents that no extra time will be needed, that is, on the assumption that the theory of exponents is to be made real.

The laboratory work in geometry would consist of the construction with great accuracy of figures and the verification by actual measurement that the proposition is true. Again, geometrical truths could be arrived at inductively. To make my meaning clear I will state a few individual cases. There is a large class of problems in which it is proved that the product of two variables is a constant. The proper understanding of these is a first class mathematical preparation for the study of Boyle's Law. Of this class, is the following: "If two chords be drawn through a fixed point within a circle, the product of the segments of one chord is equal to the product of the segments of the other." The data could be arranged as follows:

a	b	ab



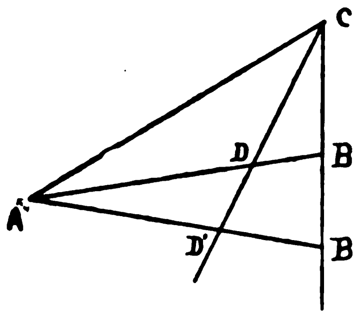
Pass various lines through P and measure accurately the lengths a and b and record in the tabuler form. The constant product in the last column will impress the fact fully as much as the rigid demonstration. If in addition to this a curve is plotted having a and b for coordinates, the exercise is complete and the proposition is seen in all its dimensions due to the added perspective.

Another large class of geometric problems is that which is analogous to Hooke's Law. An example of this class is the following: "In any triangle the bisector of an angle divides the opposite side into segments proportional to the adjacent sides." The data for this experiment may be tabulated as below:

This data is obtained by drawing various lines AB, A′ B′, etc., and measuring accurately the corresponding lines.

A third type of work suitable to the laboratory is the determination of geometrical constants, such as the value of and a radian. For such work as this the chartometer and the planimeter would be very valuable. Squared paper could be used with considerable accuracy. By the use of such paper I determined the value of π to .1% which is sufficiently accurate for all practical purposes.

There are some problems whose truth would be but vaguely realized unless supplemented by experimental verification. Such a one is the fol-



AC	BC	AC/BC	AD	BD	AD/BD

lowing: "In any triangle the square of the side opposite an acute angle is equal to the sum of the squares of the other two sides minus twice the product of one of these sides and the projection of the other upon it." From the previous experiment the details of this one are obvious.

This work would give a good opportunity to study the effects of errors in measurement. Suppose the two quantities to be measured are multiplied together and that 4 and 7 is one pair of values. The product is 28. Suppose that there is an allowable error of .5 in each measurement. This will give us for our product $4.5 \times 7.5 = 33.75$, or an error in the product of 5.75, which is 20%. This readily admits of generalization.

There should be at least one double period per week for the laboratory work which should be carried on in connection with every course offered in mathematics. In algebra and geometry perhaps not so many original exercises could be done, but what was done would be more thoroughly understood and retained. If the laboratory work crowds the student I would suggest the omission of partial fractions, series, progressions, quadratic surds, imaginaries, and some other things that are not needed in elementary mathematics or for general practical purposes.

THE ALGEBRAIC EQUATIONS OF LISSAJOUS'S CURVES.

G. E. MARSH, S.B., CASE SCHOOL OF APPLIED SCIENCE.

The curves of Lissajous though probably known to the scientific world of the eighteenth century were first studied by Nathaniel Bowditch in 1815 in connection with the motion of a pendulum suspended from two points.[1]

The algebraic equations of the curves resulting from the combinations of the two or three simplest period ratios have been known for some years though the equations of curves of all higher orders have resisted all previous

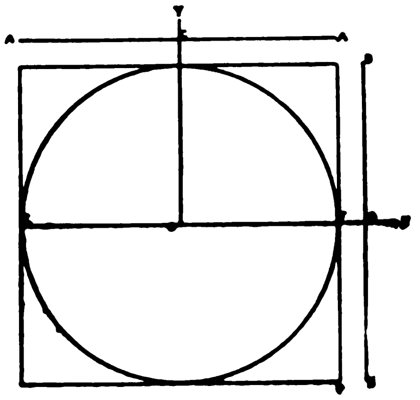


FIG. I.

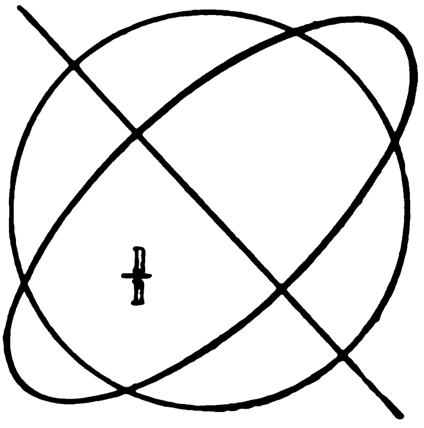


FIG. II.

efforts made toward expressing them algebraically, and on this point P. G. Tait in his article on Mechanics in the Encyclopedia Britannica asserts the impossibility of their being so expressed.

The two coplanar, simple harmonic motions, conceived as taking place in the lines AA' and BB' of the diagram, Fig. I., may be represented by the equations

$$x = a\cos\left(\frac{2\pi t}{T_1} + E_1\right), \qquad (1)$$

$$y = b\cos\left(\frac{2\pi t}{T_2} + E_2\right),$$

where the epochs are E_1 and E_2 and a, b and T_1, T_2 are the amplitudes and per-

[1] Memoirs of the American Academy, 1815. This was more than thirty-five years before Lissajous brought them to notice It is an unfortunate circumstance that they do not bear the name of our illustrious American mathmatician

iods respectively of the two motions. If n_1 and n_2 are the frequencies, the equations may be written in the equally familiar form

$$x = a \cos (2 \pi n_1 t + E_1), \qquad (2)$$
$$y = b \cos (2 \pi n_2 t + E_2).$$

Since the initial difference in phase of the two motions, that is, when $t = 0$, is the difference of the epochs, the last equations give

$$x = a \cos (2 \pi n_1 t + E), \qquad (3)$$
$$y = b \cos (2 \pi n_2 t),$$

if $E = (E_1 - E_2)$.

Two methods for the elimination of the variable t are clearly possible. (1). By introducing trigonometric values of t from the second into the first. (2). By expressing t explicitly in each equation and equating values thus obtained.

Considering the first method, the elimination of t from Eqs. (3) may be accomplished by expanding the value of x and introducing the value of the

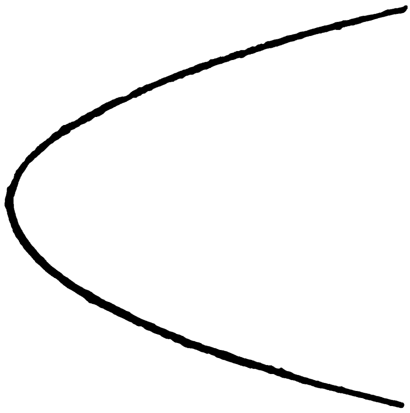


FIG. III.

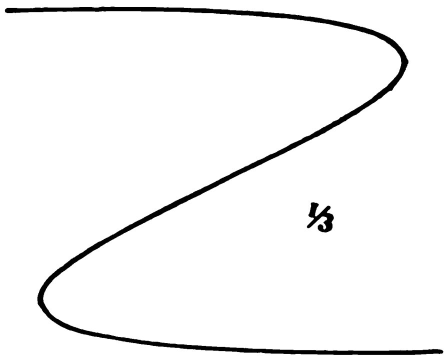


FIG. IV.

sin and cos terms obtained from the second equation. This demands that the terms in the expansion of the first equation shall be derivable from the second equation.

If $\frac{n_1}{n_2} = \frac{n}{1}$ where n is an integer, there is no difficulty involved in the process as the terms in the expansion of x may be expressed in terms of those of the first degree which is exactly the nature of those to be obtained from the second equation.

If the frequency of ratio is not an integer, the elimination is more difficult and possible only in a few cases at the most.

From (3)

$$x = a\left(\cos 2\pi n_1 t \cos E - \sin 2\pi n_1 t \sin E\right),$$

$$= a\left(\cos E\,[A] - \sin E\,[B]\right),$$

where A and B are the proper finite series for the expansions of $\cos 2\pi n_1 t$ and $\sin 2\pi n_1 t$ respectively in terms of $\sin 2\pi t$ in the first case and $\cos 2\pi t$ in the second. Making use of the same general series, the value of y may

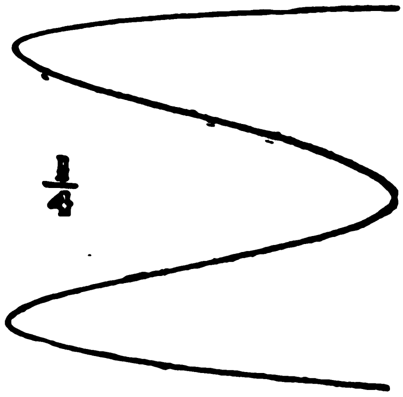


FIG V.

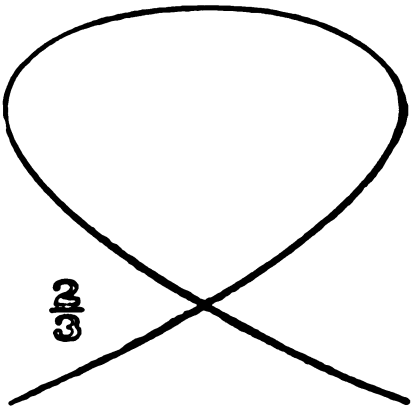


FIG VI.

be likewise expressed as an expansion in terms of powers of $\sin 2\pi t$ and $\cos 2\pi t$ as in the case of x. Even if n_1 and n_2 are small integers this method of elimination is accompanied with so large an amount of work, that of freeing the two series, composed of power terms of $\sin 2\pi t$ and $\cos 2\pi t$, of t as well as afterwards reducing results to convenient form, that there is but little merit in it. And for values of n greater than 3 the method fails completely.

Since the present paper was delivered Mr. E. B. Escott, of the University of Michigan, has called my attention to the solution of Eqs. (3) through the use of exponential imaginaries for the expression of the trigonometric terms. The method is neat though considerably longer and lacks the generality of the present one.

Returning now to the second method of elimination, there results from Eqs. (2),

$$t = 2\pi \frac{1}{n_1}\left(\cos^{-1}\frac{x}{a} - E_1\right)$$

$$t = 2\pi \frac{1}{n_2}\left(\cos^{-1}\frac{y}{b} - E_2\right)$$

$$\therefore \left(n_2 \cos^{-1}\frac{x}{a} - n_1 \cos^{-1}\frac{y}{b}\right) = n_2 E_1 - n_1 E_2 = C. \tag{4}$$

By trigonometry

$$\cos n\theta = 2^{n-1}\cos^{n}\theta - n \cdot 2^{n-3}\cos^{n-2}\theta + n\frac{n-3}{2}2^{n-5}\cos\theta^{n-4} - \dots \tag{5}$$

where the Rth or general term is,

$$(-1)^{r-1} n\,(n-r)^{n-r-1} \dots (n-2r+3)\,2^{n-2r+1}\cos\theta^{n-2r+2},$$

and
$$(-1)^{\frac{n}{2}}\, \frac{n\left(\frac{n-2}{2}\right)\left(\frac{n-4}{2}\right)\left(\frac{n-6}{2}\right) \dots \dots 1}{\left(2-\frac{n}{2}\right)!},$$

or
$$(-1)^{\frac{n-1}{2}}\, \frac{n\left(\frac{n-1}{2}\right)\left(\frac{n-3}{2}\right) \dots \dots 2 \cdot 1 \cdot \cos\theta}{\left(\frac{n-1}{2}\right)!},$$

is the last term depending on whether n is even or odd. The number of terms in the expansion (5) is $\left(\frac{n+2}{2}\right)$ if n be even, and $\left(\frac{n+1}{2}\right)$ if n be odd.

Placing $\cos\theta = m$, Eq. (5) becomes

$$n\cos^{-1}m = \cos^{-1}\left(2^{n-1}m^{n} - n2^{n-3}m^{n-2} + n\frac{n-3}{2}2^{n-5}m^{n-4} \dots\right) = \cos^{-1}(M), \tag{6}$$

provided M be taken to represent the series in the parenthesis.

The quantities M corresponding to the first ten values of n are as follows (by expansion (6)):

$$\left.\begin{aligned}
\cos^{-1} m &= \cos^{-1}(m)\\
2\cos^{-1} m &= \cos^{-1}(2m^2 - 1)\\
3\cos^{-1} m &= \cos^{-1}(4m^3 - 3m)\\
4\cos^{-1} m &= \cos^{-1}(8m^4 - 8m^2 + 1)\\
5\cos^{-1} m &= \cos^{-1}(16m^5 - 20m^3 + 5m)\\
6\cos^{-1} m &= \cos^{-1}(32m^6 - 48m^4 + 18m^2 - 1)\\
7\cos^{-1} m &= \cos^{-1}(64m^7 - 112m^5 + 56m^3 - 7m)\\
8\cos^{-1} m &= \cos^{-1}(128m^8 - 256m^6 + 160m^4 - 32m^2 + 1)\\
9\cos^{-1} m &= \cos^{-1}(256m^9 - 576m^7 + 432m^5 - 240m^3 + 9m)\\
10\cos^{-1} m &= \cos^{-1}(512m^{10} - 1280m^8 + 2120m^6 - 400m^6 + 8m^2 - 1)
\end{aligned}\right\}(6^a)$$

Applying Eq. (6) to Eq. (4) we have

$$\cos^{-1} M_x - \cos^{-1} M_y = C, \tag{7}$$

where M_x and M_y are the expansions of $n_1\cos^{-1}\frac{n}{a}$ and $n_2\cos^{-1}\frac{y}{b}$ respectively by Eq. (6) or from (6^a).

By means of the relation

$$\cos^{-1} g - \cos^{-1} h = \cos^{-1} (gh + \sqrt{1 - g^2} \sqrt{1 - h^2}),$$

which is another form of

$$\cos (x - y) = \cos n \cos y + \sin x \text{ and } y, \text{ if}$$

$$\cos x = g,$$
$$\cos y = h.$$

Eq. (7) becomes

$$\cos C = M_x M_y + \sqrt{(1 - M_x^2)} \sqrt{(1 - M_y^2)},$$

or

$$M_x = M_y \cos C \pm \sqrt{1 - M_y^2} \cdot \sin C. \tag{8}$$

Equation (8) is a general algebraic equation for all curves compounded of two coplanar, S. H. M. at right angles, of whatever amplitudes, periods

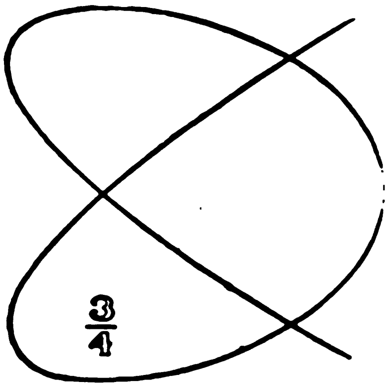


FIG. VII.

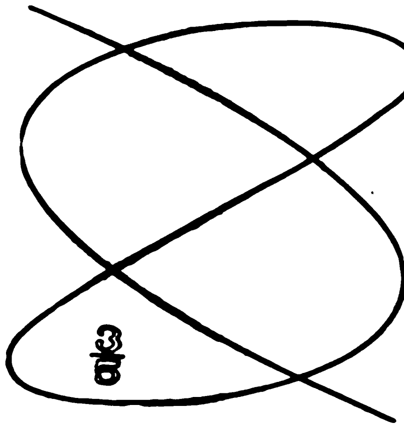


FIG. VIII.

and phase relations. The equation, furthermore, is in no sense transcedental as the trigonometric terms or phase constants are by their very nature Eq. (4), completely determined when the epochs and periods are given, and which are obviously essential for the specification of any particular curve.

If the epochs are zero, or if C = o, Eq. (8), reduces to the beautifully simple form

$$M_x = M_y, \tag{9}$$

a relation which enables the equation of the curve to be written immediately by merely taking the values of M_x and M_y from the Eqs. (6').

If $C = \frac{\pi}{2}$ or $\frac{3\pi}{2}$ Eq. (8) again takes an attractive form though by no means as simple as the one just given.

$$M_1^2 + M_2^2 = 1. \tag{10}$$

It is interesting to note also that in the values of M for odd values of n there is no constant term, none not involving m, accordingly Eq. (9) will be

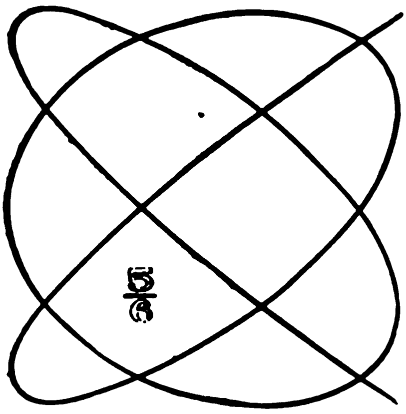


FIG. IX.

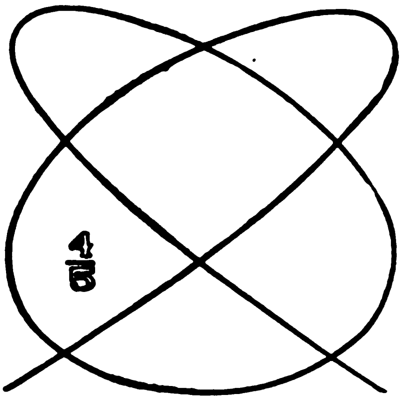


FIG. X.

that of a curve passing through the origin when n_1 and n_2 are each odd integers, and this irrespective of the values which the amplitudes may have.

It will now be interesting to consider the equations of the curves compounded of two simple harmonic motions whose frequencies are those of concords which constitute the diatonic scale.

1) When $n_1 = n_2$; the curve is that known as a perfect unison.

Eq. (8) gives with the aid of (6^2), since in every case $m_1 = \frac{x}{a}$ and $m_2 = \frac{y}{b}$.

$$\frac{x}{a} = \frac{y}{b}\cos C \pm \sqrt{1 - \frac{y^2}{b^2}} \cdot \sin C,$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{2xy}{ab}\cos C = C \sin,$$

which is, in general, the equation of an ellipse.

If $C = 0$, or π,

$$\frac{x^2}{a^2} \pm \frac{2xy}{ab} + \frac{y^2}{b^2} = 0,$$

or

$$\left(\frac{x}{a} \pm \frac{y}{b}\right)^2 = 0,$$

which represents pairs of coincident straight lines through the origin and making angles with the axes which are easily determined from the equations.

If $C = \frac{\pi}{2}$, or $\frac{3\pi}{2}$,

$$\frac{x^2}{a^2} + \frac{y_2}{b^2} = 1,$$

an ellipse, which readily gives the circle $x^2 + y^2 = a^2$ when the amplitudes become equal.

2) If $\frac{n_1}{n_2} = \frac{2}{1}$, the curve represents the octave.

Eq. (8) becomes

$$\frac{x}{a} = \left(\frac{2\,y^2}{b^2} - 1\right) \cos C \pm \sqrt{1 - \left(\frac{2\,y^2}{b^2} - 1\right)^2} \cdot \sin C$$

If $C = 0$, $\quad y^2 = \frac{b^2}{a} x + 1,$

which is the equation of a parabola.

If $C = \frac{\pi}{2}$, $\quad b^2x^2 = 4a^2y^2\,(b^2 - y^2),$

which represents a curve of the figure eight type.

3) When $\frac{n_1}{n_2} = \frac{1}{3}$ and $C^2 o$,

Eq. (9) gives

$$\frac{x}{a} = 4\,\frac{y^3}{b^3} - 3\,\frac{y}{b}\,.$$

4) When $\frac{n_1}{n_2} = \frac{1}{4}$, we have the double octave.

Eq. (9) gives, if $C = 0$,

$$\frac{x}{a} = 8\,\frac{y^4}{b^4} - 8\,\frac{y^2}{b^2} + 1.$$

5) When $\frac{n_2}{n^2} = \frac{3}{2}$, representing the fifth,

If $C = 0$, Eq. (9) gives,

$$(2x^2 - a^2)\,b^3 = (4y^3 - 3b^2y)\,a^2,$$

which reduces to, if the amplitudes be equal,

$$x = \pm \sqrt{\frac{4y^3 - 3a^2y + a^3}{2a}}.$$

6) When $\frac{n_1}{n_2} = \frac{4}{3}$, representing the fourth,

If C = o. Eq. (9) gives

$$(4x^3 - 3a^2x)\, b^4 = (8y^4 - 8y^2b^2 + b^4)\, a^3.$$

7) When $\frac{n_1}{n_2} = \frac{5}{3}$, a major sixth.

If C = o, $4\,\frac{x^3}{a^3} - 3\,\frac{x}{a} = 16\,\frac{y^5}{b^5} - 20\,\frac{y^3}{b^3} + 5\,\frac{y}{b}$,

evidently a curve passing through the origin.

If the amplitudes be equal we get a somewhat simpler expression,

$$4a^2x^3 - 3a^4x = 16y^5 - 20a^2y^3 + 5a^4y.$$

8) When $\frac{n_1}{n_2} = \frac{6}{5}$, a minor third.

$$C = o, \quad 16\frac{x^5}{a^5} - 20\frac{x^3}{a^3} + 5\,\frac{x}{a} = 32\,\frac{y^6}{b^6} - 48\,\frac{y^4}{b^4} + 18\,\frac{y^2}{b^2} - 1$$

$$(16x^5 - 20a^2x^3 + 5a^4x)\, b^6 = (32y^6 - 48b^2y^4 + 18b^4y^2 - b^6)\, a^5$$

9) When $\frac{n_1}{n_2} = \frac{5}{4}$, a major third.

$$C = o, \quad (8x^4 - 8a^2x^2 + a^4)\, b^5 = (16y^5 - 20b^2y^3 + 5b^4y)\, a^4$$

10) When $\frac{n_1}{n_2} = \frac{9}{8}$, C = o.

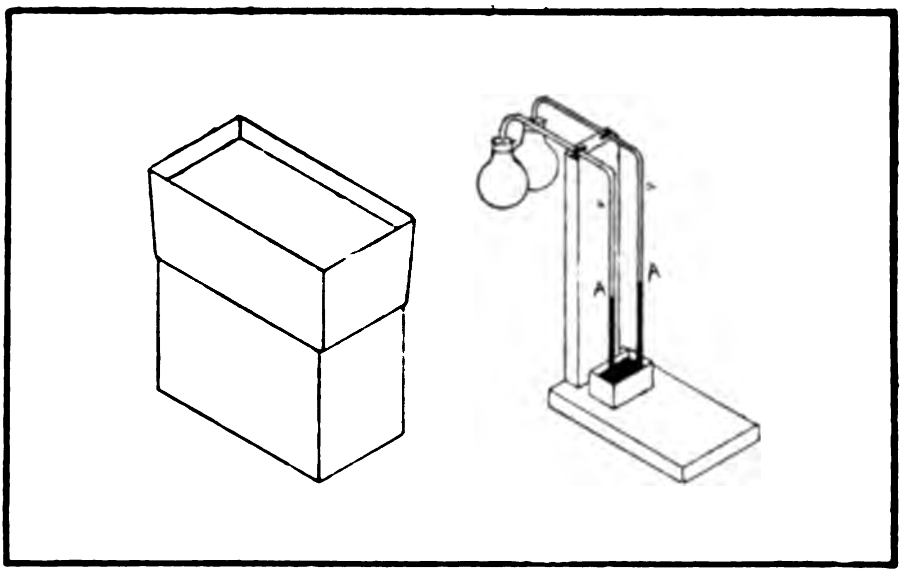
Eq. (9) gives

$$(128x^8 - 256x^6a^2 + 160a^4x^4 - 32a^6x^2 + a^8)\, b^9 =$$
$$(256y^9 - 576y^7b^2 + 432y^5b^4 - 240y^3b^6 + 9yb^8)\, a^8$$

AN APPARATUS FOR ILLUSTRATING THE EQUALITY OF EXPANSION OF DIFFERENT CASES

C. F. ADAMS, CENTRAL HIGH SCHOOL, DETROIT, MICH.

The apparatus here described is intended to illustrate before a class that different gases expand equally under similar conditions. It consists essentially of two air-thermometers of equal size supported upon a wooden standard, as shown in Fig. 1. The bulbs of these thermometers are two small flasks of about 100 c.c. capacity. The capacities of these flasks were first tested to see that they were equal and marks made upon their necks with a file to show how far the stoppers should be inserted to maintain the equality.



About 3 c.c. of sulphuric acid are placed in each flask to keep the gases dry. The vertical part of the stems of the thermometers, AA, consists of a small slim pipette or burette graduated in tenths of a cubic centimeter from 0 to 5 c.c. They were selected so that the lengths of the graduated parts are equal and the zero marks equally distant from the end. These pipettes, inverted, are connected to the flasks by glass tubing bent as shown in the figure. The union at *aa* may be made by rubber tubing, but it is an easy matter to fuse the pipettes to the tubing and the apparatus is more permanent and there is less danger of leakage. Care should be taken to have the bottoms of the two flasks at the same level and the lower ends of the pipettes should also be at the same level. These dip into a beaker containing cencen-

trated sulphuric acid. Commercial acid should be used since it can be easily seen in the tubes at a distance.

The flasks are closed by stoppers having two holes. After the apparatus is set up one of the flasks is filled with hydrogen or other gas by inserting a delivery tube of a gas generator in one of the holes of the stopper and gas passed through until all of the air is expelled. The hole in the stopper is then closed with a glass plug. The other flask is filled with air. The chief difficulty in setting up the apparatus is in making it perfectly air-tight.

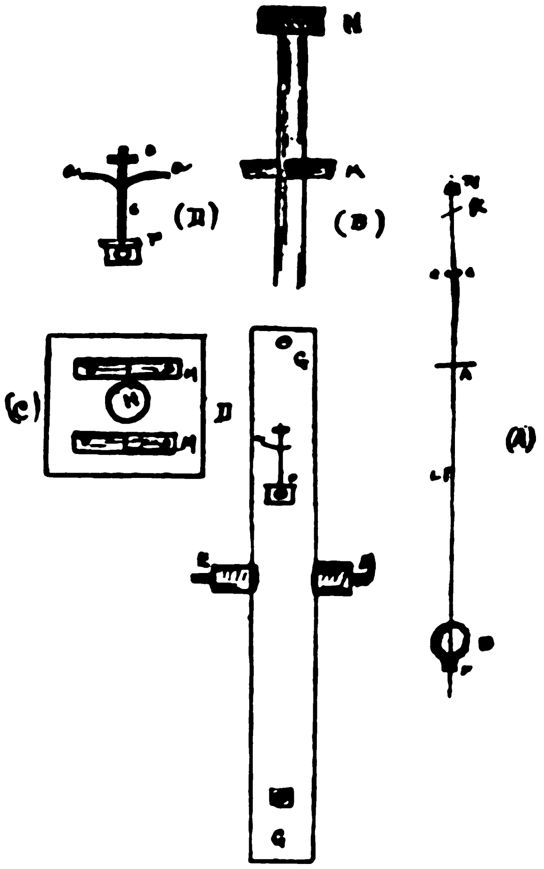
In using it a large basin of water is placed upon a box (Fig. 2) at such a height that when the flasks are placed in it and the wooden support rests on the table, the flasks do not quite touch the bottom of the basin. The support should be heavy enough to hold the flasks down in the water. Before the apparatus is used the flasks should be placed in water about 10° warmer than will be used in the class room, say about 45° C, thus some of the gases will be expelled so that at about 20° C, the acid will stand near the top of the graduation in the stems of the thermometers. For the actual experiment it is best to have two basins, one containing water at about 20°C and the other water at about 35° C. The flasks can then be placed alternately in one basin and then in the other, and the expansion and contraction noted. It will be readily seen that the experiment will take very little time in the class and that it can be repeated with very little trouble.

AN ELECTRICAL PENDULUM FOR SIGNAL SERVICE IN LABORATORIES.

W. H. HAWKES, ANN ARBOR.

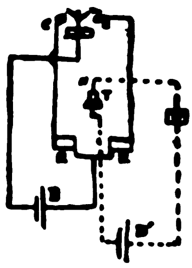
The electrical pendulum described here is offered as an instrument for giving time signals in laboratories where such experiments are made, and especially in laboratories where the expensive laboratory clock is not available. After a test running over several months this apparatus has shown itself perfectly reliable as a time keeper, any variation in its time of vibration during that time not being apparent. It is operated by a current from a single Daniell cell, this cell being chosen on account of the constancy of the current it maintains. In circuit with the battery are two electro-magnets that are alternately thrown in and out of the circuit by a little device that is the secret of the success of the pendulum. The nature of the device is that of a swinging contact key, that closes the circuit automatically on the approach of the pendulum to either electro-magnet, but at the instant of the return of pendulum the contact is broken and the pendulum swings back free, toward the other electro-magnet, till at the most effective distance from it, the circuit closes through the other electro-magnet, this in turn demagnetizes at the return of the swing, and so the uniform motion of the pendu-

lum is maintained. The pendulum carries the armature that oscillates back and forth between the electro-magnets, and upon which the magnetic pull is exerted. The construction of such a pendulum is quite within the limits of the amateur mechanic. Provide a rod of brass or wood, preferably wood, as it is less susceptable to changes in temperature, with a bob of about 8 pounds weight, with adjusting screws beneath as in Fig. A. Mount on this rod armature at A, needle for mercury contact at L. Platinum tip terminals for contact in closing the circuit through a and a' as the pendu-



lum swings (Fig. D). The pendulum may be hung by the conventional spring lug at the end or if the rod is brass a piece of file (k. Fig. B) smoothed to an edge is soldered into a slit cut in the rod and the pendulum passed through the hole H (Fig C) swings with the sharp edge resting on the brass strips M M screwed to the shelf D. The adjusting screw, N (Fig B), may then be used for a fine adjusting of the pendulum for

accurate time vibration. The pendulum thus fitted is hung on the board, G, screwed to the wall. The swinging contact a. a. that closes the circuit through the electro-magnets is constructed by taking a piece of brass, s, about 1-16 inch in diameter and two inches long, pointing the lower end; a thin piece of brass or copper is soldered on to this shaft as shown in the cut (D). This is then mounted with the point P resting on a brass shelf and the upper end lightly strapped to the board at O. The electro-magnets E, E, are made of No. 20 cu wire and are about 1½ inches in length by 1 inch in diameter, the cores extending about ½ inch beyond the end of the helix, for greater strength of magnetism and convenience. These electro-magnets are fastened on some convenient support about ⅓ the distance down from the point of suspension of the pendulum to the bob. These are connected in a double circuit system with the Daniell cell as shown below. The diagram also gives the connections for mercury contact in the sounder circuit.



PENDULUM CIRCUIT.

cc = Contacts on Pendulum.
aa = Swinging Contacts.
EE = Electro-magnets.
B = Battery (Daniell).

SOUNDER CIRCUIT.

T = Mercury Contact.
N = Needle, or Pendulum.
S = Sounder.
B′ = Battery (Leclanche).

THE PURIFICATION OF MERCURY

W. H. HAWKES, ANN ARBOR.

Clean mercury is a laboratory essential and the ease with which mercury becomes impure makes a stock of clean mercury hard to keep. The method of distillation is difficult and tedious of operation without special and expensive apparatus and is attended with considerable loss of both mercury and time.

The following method will save all this and will enable laboratories to keep their stock of mercury clean and in good condition ready for use when needed.

Provide a cylindrical jar 20 cm. long by 3 cm. diameter, a stick of common electric light carbon (without copper coating), a Sprengels air pump (aspirator), rubber tubing, two-hole rubber stopper for the jar, one and one-half feet of glass tubing of proper size for the stopper.

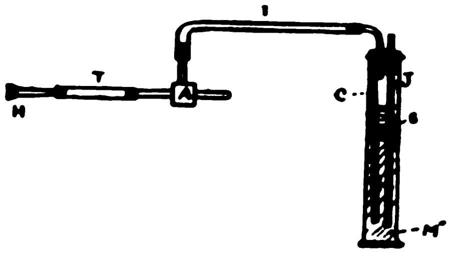
Cut the glass tubing into two pieces, one piece long enough to reach

nearly to the bottom of the jar, extending through the stopper about one inch. Bend the remaining piece into an L-shape, inserting the short arm through the stopper about one inch. Connect the aspirator by proper-sized rubber tubing and the water faucet; to do this it may be necessary to use a reducer joint to fit the tubing, that may be obtained of the plumber. Connect the other end of the aspirator to the outer end of the L tube. The apparatus is now ready for use.

The process of cleaning is briefly described as follows:

Fill the jar a little more than half full of the mercury to be cleaned. Pour in on top of this dilute H_2SO_4 (1-8) to the depth of about 1½ inches. Insert a rubber stopper having no perforation and rock the mercury back and forth through the acid, bringing the mercury well in contact with acid. Take out the stopper and insert the stick of carbon reaching nearly to the bottom of the jar: insert the stopper with the tubes; turn on the water until the air bubbles up through the mass of mercury freely. Allow this process to continue from 20 min. to half an hour, according to the condition of the mercury. If the mercury is very dirty, pour off the acid and put in some fresh and continue the process 15 or 20 minutes longer. Then pour off acid. Wash the mercury thoroughly in clean water until there is no trace of acid in it; then dry it by thrusting filter paper into it. Finally filter into a clean

DIAGRAM SHOWING ARRANGEMENT OF PARTS.



H = Faucet
TT = Connecting Tubes
A = Aspirator
J = Jar
M = Mercury
S = Electrolyte
C = Carbon

vessel and the process is complete. If the work is properly done there will not be the trace of a film upon its surface, nor will it leave any stain or trail on porcelain. The process requires no attention while the purification is going on, no expense except that invested in the apparatus, and practically no loss of mercury.

The process of purification involved is electrolytic. The impurities in the mercury, acting as one electrode while the carbon acts as the other, the electrolyte being the acid. The object of the aspirator is to keep the mass well agitated, bringing the surface of the Hg. constantly in contact with the acid and carbon, with a slight oxidizing process attending the passage of the air through the mercury. In the process the impurities of the mercury go into solution and of course is washed out afterward. If the mercury is decidedly greasy or oily, use caustic potash instead of H_2SO_4, leaving out the carbon, washing and drying in the same manner as above.

It will quicken the process to filter the mercury before subjecting it to the process above described; in fact, filtration will often take out all the coarser impurities that only interfere with its use for certain experiments.

The accompanying diagram will assist in setting up the apparatus.

BIOLOGICAL CONFERENCE AND SCIENCE TEACHING

AIMS AND METHODS IN ELEMENTARY FIELD WORK.

I. B. MEYERS, THE UNIVERSITY OF CHICAGO SCHOOL OF EDUCATION.

In outlining this paper I have confined myself to the beginning or elementary phases of field work. My effort is to indicate a line of progression rather than attempt to go into details as to methods of procedure. This paper is controlled by the thought that the pupil is a greater consideration, at this stage of school work, than the subject.

We may recognize two fairly distinct stages in field work—(1) A stage when the pupil is largely dominated by the pleasure he derives from physical activity, seeing new things, gaining new sense experiences, acquiring skill, satisfying his restless and insatiable curiosity. This is the very elementary stage, and may be termed a period of radiation. It is a period not very fully recognized by our courses of study and one for which they have not well provided. (2) The second stage is the period when the pupil through special aptitude or experience develops dominating interest in some special phase of study and confines himself largely to a particular subject—this marks the beginnings of specialized work. There are all gradations between these two phases. It is important that we consider whether the character of the work of pupils during this *period of radiation* has any positive value in case the student never reaches the period of specialized work and second whether it prepares him for the more specialized work of later school life; in so far as it fails in either of these two ends it must be considered insufficient and in so far as it fulfills these two conditions it must be considered efficient and practicable. In this process of educating there are two prime considerations (1) the various phases of knowledge which have been accumulated, sorted, and systematized, and given a position in the course of study—physiography, botany, zoology; (2) the human being known as the pupil. The process of educating is conceded to be through some interrelation of subject with pupil or pupil with subject, and it is our view point as to the nature of this interrelation that is the crucial thing in our "aims and methods of teaching."

Either these subjects which make up the course of study are selected as types of knowledge to be learned by the pupils; the amount learned being

the measure of educational progress: *or* they represent types of knowledge to be used in developing desired qualities of physique, mentality, skill and working efficiency, the power gained in these directions ***being the measure of educational progress.*** The distinction may not always appear clear cut or essential but the path of school progress is strewn with the wrecks of methods which were founded upon the conception that the function of teaching is wholly concerned with inducing pupils to learn the subject, and the methods have ranged from that of Gad Grinds through all types of pedagogical novelties which were warranted to induce, lead or trick, the pupil into learning the desired subject. There exists, however, a growing belief that the subject may be so taught that the act of learning will prove to be the vital factor in education; a belief that the pupils' interests may form a basis for educational procedure and progress.

However well we may have formulated and stated the laws which relate to individual experience and self activity and however strong our belief in them as the fundamental basis of human development, we must admit that the application of these principles has not been a controlling factor in educational practice. If we can find a type of school work rich in a subject which appeals to the instincts and interests of the pupils, and which at the same time offers exceptional opportunities for individual initiative and self effort; then I believe that in the use of this subject the problem of individual development and the problem of knowledge of the subject are on a fair way to complete solution, the two things will prove to be interdependent.

Gaining an acquaintance with the sciences through field work must surely have quite a different influence upon the student from that of the text-book and laboratory method, especially when his field experiences are supplemented by related reading and experiment.

It is the function of elementary field work to recognize and give more freedom to the natural instincts and interests of students and by so doing beget in the students, through personal contact, a familiarity with nature and her ways. The keynote of the work is individual interest and effort, the crucial point, pedagogically, is that the interest and mental movement aroused by this direct contact shall not be smothered by the text and the teachers descriptions. These should be strong aids in enlarging and intensifying this mental movement but the teacher should be careful not to divert or dominate it. "The facts of science have been so abundantly acquired, so thoroughly systematized, and rendered so easily available through text-books, manuals and models that we frequently resort to the teachings of these schemes of knowledge instead of the knowledge itself."

Field work brings the pupil in contact with materials and phenomena which, through sense experience, investigation, and inference, he converts into knowledge. The value of this field work is very largely determined by the way we use it and what we expect to gain through this use. One of the mistakes of field work is the practice of using it to supplement or illustrate our indoor class work; this is better than no field work, but I do not believe that it is the best use.

This leads to a habit of trying to fit facts to theory, rather than formulating inferences and theories out of observed facts. It is the experiences, materials and thoughts of the field which should be brought to the class room and form the basis for the recitation, for reading, and experimentation. The problem is whether, at this beginning stage of science, the text and manual shall be centers for student effort or whether the out-of-door environment shall be the center and the text, manual, and laboratory constitute the aids to the study; whether the field shall supplement the indoor equipment or whether the indoor equipment shall supplement the field work.

Field Work.—The materils with which pupils come in contact in field work may be grouped under the heads of (1) Climatology, (2) Physiography, (3) Mineralogy, (4) Botany, (5) Zoology. In our text-books these constitute distinct sciences and are treated separately; in the field we find them intimately interrelated.

There comes a time, very soon, however, when it is desirable that this work take on something of the spirit of conscious purpose and study.

In the School of Education we have found the school garden a most fertile aid in this transition. The idea of planting is readily grasped, this working with the soil, handling tools, digging and planting appeals strongly to the pupils' instinct of workmanship.

With a definite purpose in mind and a certain impatience to set to work, the pupil faces a whole series of new problems. He begins to grasp the idea that in raising plants results depend largely upon the fulfillment of certain conditions. He must gain information as to time of planting, preparation of the soil, depth and distribution of seeds, care of plants.

Going hand in hand with the work are a series of problems which spring directly from the garden work:

1. A study of the various ways in which new growths arise, seeds, bulbs, tubers, cuttings, etc.
2. Conditions essential to start new growths,—temperature, moisture.
3. Advantage of placing seeds in ground.
   (a) Uniform moisture conditions.
   (b) More uniform temperature.
   (c) Depth of planting.
4. Amount of moisture absorbed by seeds to start germination.
5. Amount of moisture in given volume of soil.
6. How this moisture reaches the seed and plant.
7. Amount of moisture required in various soils to support various plants.
8. Weeds and cultivated plants—why weeds can overcome cultivated plants.
9. Light and plant growth—purpose of weeding—green of plants.
10. Nature and origin of soil.
11. Insect life, bird life, earthworm, etc.

We try to parallel this garden work by considering the questions relating to uncultivated areas; nature's method of planting and weeding; number of seeds germinating on a given area; seed distribution; temperature and life; meaning of early green spots, etc.

These problems do not come to the pupil as assigned lessons but they spring out of his from day-to-day experiences; and the answers to these questions are essential to the continuation of certain particular phases of thought and action. In the earlier or "rambling" stage of this out-of-door work the pupil was guided largely by his instinct of curiosity, when his curiosity was satisfied there remained no logical reason why he should give the object or phenomenon which attracted his attention, any further consideration. The pupil may begin work in the garden under much the same impulse, but by his act of planting he assumes certain duties which may lose their pleasureable elements—but which must be attended just the same in order that he may succeed in his original purpose—the repeated need of destroying weeds and loosening the soil may serve as an example.

It is comparatively easy to do a bit of work when results follow immediately, but it is quite a different matter to work patiently and conscientiously when results are remote. The development of this quality is one of the important functions of teaching. It seems to me that it is just at this stage where the frequently agitated question of discipline comes in—by the act of planting the pupil becomes responsible to a degree, for the fruitage, and nothing short of his best efforts to obtain adequate results should be allowed to pass; he has begun work with a definite purpose; nothing short of the accomplishment of the purpose shall satisfy him. This general science work is usually carried on under the head of Nature Study which has been a strong factor in recognizing the child's interest in nature and extending the range of his experience with nature; the weak point of the work has been in a general failure to provide means for accumulating and unifying these observations and experiences. Much time and energy is spent in observation, experimentation, and collecting data, but when the time comes for a more adequate working up of this data, for its broader interpretation we find that much of it has oozed away. While it may have broadened the interest and trained the senses it has not always given a type of mental poise and control which insures the pupils making best use of experience. We need to give more special attention to devising means for accumulating the more essential observations. There are a variety of ways in which the pupil's from-day-to-day experiences may be accumulated,—

1. Experiences relating to climatic conditions.
   (a) Character of the day—sunshine, clouds or rain.
   (b) Direction of wind during each state of conditions; (1) winds that bring clouds; (2) clearing winds.
   (c) Daily range of temperature,—winds and temperature.
   (d) Daily range of barometer.
   (e) Time of sunrise and sunset and position as to east and west;

(f) Noon position of the sun-degrees from the vertical at various seasons and influences on temperature.

(g) Records as to the conditions of life at various seasons and adaptations to climatic changes. Following this period of record taking comes a period of summarization and interpretation; a more definite study of climate and climatic controls.

These records have little significance if we collect our data from books and charts but they are full of meaning to the individual who has accumulated these records from nature. As the garden and these records afford opportunities for unifying experiences out of which we may formulate a series of problems so the natural features of the landscape may be made to serve a similar purpose. The surface of the earth of any region may be considered as consisting of a number of type topographic or rather physiographic features; these may be grouped under the headings of

1. Shores and beaches of varied types and their associated features.
2. Lakelets, lagoons, and marshes and their associated features.
3. Gullies, ravines, valleys and their associated features.
4. Hummocks, hills, and ridges and their associated features.
5. Levels, flats and their associated features.

Each one of these types may be considered a unit environment and as such a center for unifying the various phases of study pertaining to it.

Each region is largely controlled by a special set of physical conditions; a complete study of any one of these centers should lead to an intelligent appreciation of the contents of the area, their true relationship, and the factors which most influence the type of region. If the action of certain forces as running water, glaciers, winds, wave action, has moulded the contour of the earth's surface, and contour and structure modify the physical conditions of moisture, temperature, light, and wind, and these in turn influence life, then our study of the area should develop an intelligent appreciation of these interrelations. Our frequent failure to have pupils study a region as a region, to learn, to enjoy, appreciate, and read landscape and its life, before taking up the isolated studies of Physiography, Botany, and Zoology, reduces greatly their breadth of outlook and the effectiveness of teaching and student effort.

One of the prominent features of the Chicago region is the marsh;—Something of the attractiveness of this type of area is indicated by the way it is frequented by the physiographer, the botanist, the zoologist, flower pickers, hunters, and wandering boys.—In the study of this area the specialist is absorbed in his particular subjects; the non-specialist tries to take a more comprehensive view—he is there to study the marsh as a unit, and we may consider that he has formulated some such outline as follows to guide him in unifying his study:

1. Gaining a good impression of the general physiognomy and atmosphere of the marsh.

2. The conditions essential to the formation of a marsh, (a) Topographic conditions, (b) Structural conditions, (c) Climatic conditions.

3. The various ways in which marshes may originate, (a) Genesis of the marsh under consideration, (b) Changes which the marsh has undergone since its genesis.

4. Acquaintance with the content of plant life of the area, (a) Its zonal distribution and conditions controlling this distribution, (b) Its adaptations to the physical conditions of the area.

5. Acquaintance with the animal life of the area, (a) Its distribution within the area, (b) Its entrance into the area, (c) Life histories and adaptations.

6. The ultimate end of the marsh as a marsh, and how this end is brought about.

It is safe to assume that the elementary student gives little attention or thought to these problems. The things that appeal to him are the mud, the cat-tails, lily pads, tadpoles, frogs, and crayfish; how the marsh got there, from whence these things came and whither they are going does not trouble him. It is sufficient that they are there and he sets to work to get all the pleasure he can by discovery, observation, and collecting. It is our first duty to see to it that he gets a broad experience with these things.

The region as approached by the student gives little hint of the problems outlined above; these problems are to grow out of his swamp experience and study. If we are going to study the marsh and begin in the primary grade it will not be necessary to give any very detailed directions as a preparation for the trip; if we are going to study some special phase, and begin at the period of 10-12 years, then directions are essential. If we see to it that adequate provision is made for the care of collected materials we may rest assured that with but little field direction a very considerable amount of materials will be secured for the school room study. The interest and work of the future trips will be largely determined by the use made of this collected material; and out of this study should evolve definite problems and preparations for a succeeding trip. No preparation can equal these unsolved problems which the pupils carry with them from the recitation.

In addition to the regular discussion relating to the trip, and this material, part of the material may be used, (1) for accumulating certain records in writing, drawing, and color.

Ex. Showing in color or drawing the variety of plants growing in the region, this record includes all the elements involved in any drawing or painting lesson and has the additional value of acquainting pupils with the type and the names of plants growing in a marsh region.

Another type of this material may be placed in boxes, jars or acquaria for detailed observation and record. (a) Development of frog, snail, aquatic insect and salamander eggs. (b) Movement and respiration of aquatic form. (c) Food and feeding habit. These may for the time being be considered special studies; but the results add continually to our growing conception of the marsh.

Another method of work is in preserving the material itself and in selecting and arranging this material to bring out certain special phases of knowledge. (1) The preservation of the animal forms of the swamp area in order to see together the full range of aquatic forms; for identification and to be used later to develop the principles of systematic classification. (2) Collecting and arranging material to show the successive stages in development of frog, salamander, insect. (3) Collecting to illustrate food and feeding. (4) Meaning of color.

These collections should form the center of a school museum, a museum not of curios and miscellaneous materials, but a museum which represented the thoughtful and intelligent work of a body of students and teachers, not a collection of case-locked curios but materials to be used and developed in school study. This method of work makes it possible to bring under intelligent inspection a vast quantity of materials otherwise so separated by time and space as to remain meaningless. Each of these collections represent a separate study and each separate study unites to form the basis for a still more extensive study. Each study gives the pupil a definite problem, gives him an opportunity to be active in his work, develops skill, and fixes in a never-to-be-forgotten way a group of essential facts. These various types of ways of dealing with field materials is legitimate elementary work: Developing skill in reading, writing, painting, observation, experiment, all of which represents types of work thought of as belonging to elementary school work. We give the pupils all of this but the getting is not made an end; these things represent means. Here is a definite work to be done and the essential skill is acquired in the doing.

As these things accumulate, paintings, charts, collections, they exert a mighty influence upon the work of the student; they give him standards, he becomes eager to do better work, his purposes become more clearly defined, he becomes alert and alive to the things around him. The work becomes more and more the product of his own initiative and less of an assigned task. The thought horizon of the pupil broadens and he gradually acquires the power of more comprehensive generalization. Minot has made the statement that "great new thoughts are generated more by the accumulation of observation than by deep meditation; a generalization is a mountain of experience." This elementary field work should stand for this accumulation of observations, this mountain of experience, for the acquirement of skill, and for the development of the intellectual qualities of alertness, thoughtfulness, patience, definiteness of purpose and power of inference and generalization.

Through this elementary field work the pupil has had experiences with marsh, hill, valley, and prairie, he knows something of the contour of the earth's surface, he has seen something of the work of running water, gravity, waves, and winds—to him topography is something which may be read and explained. He has collected data which gives him hints as to climate control and the influence of climate on life. He has had some chance to feel his own worth.

If our elementary work can succeed in developing in pupils (1) A feeling of pleasure in nature, (2) An intelligent attitude towards nature, (3) can succeed in having the pupils detect the problems relating to their out-of-door environment, and (4) have them gain some power in knowing how to set to work to solve these problems it will have accomplished a great work. The value of this work must be tested by its influence on the individual and not upon the basis of systematic knowledge; knowledge may be the test when the student has had ample time to more fully systematize and complete these various phases of study but at this elementary stage the test must be based on working efficiency. Having acquired working efficiency, having, as it were, learned his trade of how to study, we may then hold him responsible for the accomplishment of some worthy work. It is the function and duty of the teacher in this elementary work to formulate an ideal as to the personal qualities which a student should possess; he should give thoughtful attention to the conditions essential to the development of these qualities, and then set to work with all the resources of knowledge to the accomplishment of this purpose. It is in this way only that we can hope to develop a science of teaching. I see no study which has the possibilities of contributing so much to this purpose as field work.

DISCUSSION OF ELEMENTARY FIELD WORK: AIMS AND METHODS.

PROFESSOR L. H. BAILEY, CORNELL UNIVERSITY.

I agree most heartily with the propositions that have been put forward by Professor Myers. I am particularly pleased with his attitude towards the field work and the excursion. The whole tendency of education is to put the school and the child into actual sympathetic relation with his environment. Biological work should normally and naturally be outdoor work. The indoor laboratory should be a supplement to the outdoor work, but it has been the fault of much of our teaching that the outdoor work has been dominated by the laboratory. It is the laboratory and not the field work that is the adjunct. It is very difficult to manage excursion work without having it become mere recreation or a rambling outing. It is not necessary to tell the pupil what is to be seen when he goes abroad, but usually he should go with a definite purpose in mind. At one time he may go for the specific purpose of seeing the edge of a swamp, a hill, or a particular tree or a particular bird, or a definite part of a brook or pond. He may go to study fish or turtles. The object of the excursion should be clearly outlined before the children go abroad and their work then becomes relevant and concrete. It is well enough, of course, to take the whole school on an outing two or three times a year. This, however, must be looked upon as a picnic rather than as definite educational work. When it is the

purpose to make the excursion of educational value it should comprise as few pupils as possible. It is difficult to handle as few as twenty pupils in many kinds of excursion work. From six to ten is a better number. This, of course, precludes the possibility of doing any definite excursion work in most rural schools of one teacher, since the remainder of the pupils would then be left uncared for.

I think that there is danger in making an excursion as formal and as perfunctory as much of the laboratory work has been. We are in danger of forgetting that the spiritual quality of school work may be the thing most to be desired. The biological work is not expected to supply the formal "drill," but rather to provide the quality and vivacity of school work. It develops the native powers of the individual and arouses and stimulates, and sets the pupil definitely at work with a personal problem.

It seems to me it is time that we should consider the industries and the affairs of the community as coming within the realm of the school enterprise. Study the creamery of the town and various other industries. The affairs of men are immensely important to the child and certain of these subjects can be made teachable by being unified, systematized and developed as to standards.

Work in the field may be carried on along several different lines, as follows:

I. THE WEATHER.
- *First year*—Very general weather observations. Try to eliminate the habit of complaining at the weather.
- *Second year*—Study of clouds, with observations on a sun-dial made by the manual training department.
- *Third year*—Study of the wind.
- *Fourth year*—Study of temperature and observations on the thermometer.
- *Fifth year*—The barometer, weather maps, signals and forecasts.

II. SCENERY—Survey of country. Strive for an understanding of topographic forms and in the
- *Third year* begin a regular survey of a brook, a swamp, or a hill in your region.
- *Fourth year*—Continue the survey and take measurements.
- *Fifth year*—Describe and plat the same area.

III. ANIMAL POPULATION OF THE REGION. The first year teach the names of the most familiar animals and plants. The second year commence a particular study of special groups of animals, beginning with birds and concluding in the fifth year with insects.

IV. SIMILAR OBSERVATIONS ON PLANTS.

It is, of course, quite impossible always to find the objects and the phenomena in the open field that one desires for the best work. Every good school, therefore, should have a new type of biological laboratory. This

laboratory is the school-garden. The school-garden should be introduced not for the purpose primarily of teaching gardening, but in order that the pupil may have a natural realm that is under more or less control. The time is coming soon when the school garden will take the place of much of the indoor laboratory work because it is more normal and natural, and is more likely to develop indigenous and native powers. It teaches handicraft in cleaning and caring for tools, laying out of walks, making flower beds, etc., and is the place to learn how plants grow. It is a scene of life.

AIMS AND METHODS OF PHYSIOGRAPHIC FIELD WORK IN SECONDARY SCHOOLS.

PROFESSOR M. S. W. JEFFERSON, STATE NORMAL COLLEGE.

Physiography is the old Physical Geography plus field work. It deals in good part with landscapes and processes, which may be studied through: 1 Pictures. 2 Maps. 3 Books. 4 The objects themselves.

Hitherto only the first three ways have been much attempted, but the burden of proof should rest with any one who ventures to justify such an arrangement or that we ought to study symbols rather than things.

Why not study the forms themselves? We do not enjoy a picture or a song or a dinner by reading about it, but by seeing it, hearing it, or eating it. If out of reach we may take some pleasure in the description, but not with any thought that we are having something as good as the thing itself. And even what little comfort there is in this second-hand treatment comes from previous dinners, songs, and pictures that we have actually enjoyed. Let us then see the near processes and landscapes and try to understand as much as we can of them. So we may hope for a better understanding of distant scenes and processes. As in every study, we are trying to master symbols and we cannot do this by omitting the things to which the symbols refer.

METHODS.

The teacher should catalogue the physiographic features of his neighborhood and arrange them in the order of importance from their generality of application in the science. Do not plan a lot of excursions. Ask for time for one—but be sure to make that a good one. Limit the number to go and plan the lesson with great care. By questions the class is gotten to look at the details concerned and to find reasons for conditions which should always be fairly easy to find in the first lesson. For instance, go to a brook. Ask, where are the biggest pebbles? Where is the smallest stuff? Where is the water going fastest? Why are the big pebbles over there? Perhaps no one can answer at first. Put some fine material in swift water and then ask again. Then the class may be asked to find other illustrations.

Probably the field trips should come first. But you plan it so and perhaps it rains, so it may be necessary to take the book lesson first.

It is impossible to apportion the number of field and class exercises, but doubtless one in three or four would be the most. But the most important consideration of all is that the teacher herself must be in sympathy with field work and shall be able to *see*. See Journal of Geography, February, 1905.

DISCUSSION OF AIMS AND METHODS OF PHYSIOGRAPHIC FIELD WORK IN SECONDARY SCHOOLS.

PROFESSOR R. D. CALKINS, CENTRAL NORMAL SCHOOL.

While nearly everyone who is entitled to express an opinion recognizes that out of door work is the one thing that is chiefly lacking in the geographic instruction of our state, there are so few who are attempting it. At the present stage of development if the few advocates spend their time at such meetings in quarreling over the methods of field work when the vital question is not so much the method by which the work is done as that field work shall be done or attempted—more harm will be done than good. Need of the hour is that friends of modern geography shall unite in spite of minor differences and create a public opinion which shall sweep the state and compel certain much needed improvement in geography teaching. And so I say Amen to all Professor Jefferson has said.

He has shown convincingly and without need of further discussion why field work is necessary—and yet I feel that there are many superintendents who feel that all this uproar about laboratory and field work is all nonsense, else why do they allow the same old methods to continue in their schools?

Granted that they are anxious to do the work but are hindered by obstacles:—

(1) Material equipment, etc., easily supplied.

(2) Arrangement of classes, so as to give time for field work, only requires a little gumption on the part of the superintendent.

(3) Lack of teachers who can see about them the forms and processes which make clear the book statements concerning them chief difficulty.

Physiography teaching has not yet evolved to the point where a discussion of the aims and methods of field work is of the greatest possible value; when there are not—how many?—shall I say fifty, forty, thirty teachers in the state who are capable of doing field work!

Something ought to be done to create a demand for science teachers who can teach physiography. The work in normals and colleges is largely elective, so superintendents must ***demand*** that science teachers shall elect physiography along with botany and zoology, or physics and chemistry.

But leaving all this and taking up the question of methods of field work, can there, under the varying conditions of environment and experience of

the teachers, be any general or universal method of field work? Must not a discussion of methods resolve itself into a testimony meeting where each merely gives the results of his own experience? Such a comparison would be valuable to those who are trying to get some aid or suggestions for conducting such work. Does it not all rest with the teacher and his preparation?

The only basis which I can see for a discussion that would yield any profitable returns, is the question of whether the field work should precede or follow the class exercises, and even here no one would ever insist that either the one or the other order could or should always be followed. But whichever order be used it must necessarily follow that the method employed will differ radically from that used if the opposite order be observed. That the field trip should precede were it not for the uncertainty of the weather, etc., I do not believe to be always the case.

Were the class composed of third or fourth grade pupils still in the observational state of their mental development, there would be little question as to the order. But with tenth or eleventh grade pupils who have advanced to the reasoning stage and that with little if any training in observation, it may well be that the class may be led deductively to certain conclusions before going into the field, with the result of increased interest and attention in the field work which follows.

This statement will vary as to its truth, not only with the pupils but with the topic under consideration. As illustrations let us take

1. The case of the origin of gullies and their development into valleys with permanent streams. By appeal to the student's general experience and by deductive reasoning under careful questioning the class may be given a preparation for the field trip which is to follow that will enable them to do some independent observing of their own which then may be supplemented by the teacher's pointing out what he has not seen. There are often many reasons why the field trip should follow the class exercise or recitation.

2. But in the study of the glacial phenomena it is essential that field study of the glacial drift, for example, should precede the text-book.

It all resolves itself into this: That order or method is best which in the judgment of the teacher using it accomplishes most satisfactorily the results aimed at.

AIMS AND METHODS OF BOTANICAL FIELD WORK IN SECONDARY SCHOOLS.

DR. H. C. COWLES, UNIVERSITY OF CHICAGO.

One of the great aims in botanical field work should be to keep alive the love of nature. With most children the love of nature is choked out at school because so many other things are crammed down, and at home it is clubbed out because the child brings in mud. The whole education of the child is away from nature. All *science* teaching is more or less artificial. It is necessarily so and even the need of microscopic work in the high schools must be admitted. All people may be divided into two classes: those who travel by day and those who travel at night. To one who has eyes to see the things of nature every journey will be full of interest. Even a trip through Arizona in midsummer may be one of greatest interest and pleasure.

The first Botany, in the days of Gray, brought a certain nearness to nature, but we felt it to be rather purposeless and unscientific. Then came laboratory morphology which was scientific but lost the nearness to nature. Now ecology combines both.

But as desirable as field work is, it should not be attempted unless it can be orderly and definite. To be a success it must be better organized than laboratory work, just as laboratory work must be better organized than recitation work. For instance one trip may be to study the habit of growth and the forms of mosses, another the lichens, etc.

The best type of field work is a study of adaptations combined with a study of structure and function. If roots are to be studied—dig up plants to see the few roots of water plants, and the extremely large roots of dry soil plants, then take them to the laboratory for microscopical study. The form and size of leaves may be studied in their relation to light; then have experiments on heliotropism, transpiration, and starch making. Make the starch test on leaves that grow in the shade and those that grow in the sunlight.

Herbaria may be turned along ecological lines. Instead of being grouped according to families, they may be grouped as peat bog plants, sand dune plants, rock plants, leaf types which are mesophytic, leaf types which are xerophytic, etc.

The study of plant associations is the most difficult of all field work, but even here something may be done and the students' accuracy may be cultivated by making maps. A study of the changes going on may be made by letting students of one class make a map of a certain region and the next class make a map of the same area.

One of the greatest difficulties in carrying on field work is that of large classes, but an enthusiastic teacher will find ways of overcoming even this difficulty. Time in which to do the work is often hard to arrange. The time ought to come when certain half days will be set apart in the

school schedule for field work. Of all the difficulties suggested that of no good place to take the classes is the most inane nonsense. A more unpromising place in which to do field work could hardly be thought of than the down town districts of Chicago, yet even here vacant lots furnish abundant material for study, and transportation makes other regions easily available. The greatest difficulty of all is bad teachers. Teachers may be classified into those who are teaching for the money there is in it and incurable teachers. By incurable teachers is meant that class of teachers who have such a love for the work that they would rather teach than do anything else. They are the only class who should teach at all and certainly are the only teachers who should attempt field work.

DISCUSSION OF AIMS AND METHODS OF BOTANICAL FIELD WORK IN SECONDARY SCHOOLS.

E. L. MOSELEY, SANDUSKY HIGH SCHOOL.

I am told that most high school botany teachers do not make a practice of taking their pupils to the fields and woods. The difficulties to be encountered in such an undertaking appear to be overestimated. The advantages are well worth the effort. Not knowing what points would be brought out in Professor Cowles' paper, I can perhaps do no better than to tell of the methods employed at Sandusky. No doubt much improvement could be made there, and these methods might be wholly unsuited to some schools. In describing our excursions I cannot adhere strictly to the subject assigned me, for while many of our excursions are mainly for botanical study, observations pertaining to zoology and physiography almost always form a part and in many of the excursions an important part of the work.

TIMES.

Our excursions are at various times. On a fine day a class is sometimes taken out at its regular recitation period for a walk through the park or along a street bordered with spacious yards where a variety of trees may be found and in May wood warblers of several kinds and other birds may be seen. The class is back at the school house at the end of the period unless it is followed by recess or noon intermission. In the latter case it is dismissed at the same time as the school without returning. These peripatetic lessons are not announced beforehand and are not so frequent as to be expected, but come as a pleasant surprise. They might profitably be given more frequently at Sandusky and at many other schools where surroundings are suitable.

In the spring, excursions, previously announced are given after school and each pupil in botany or zoology has an opportunity to go about once in

two weeks, sometimes oftener. Some of them are open to the whole biology class, about sixty; those intended especially to see birds are often limited to one of the two sections, but if a pupil has work to prevent him from accompanying his section, no objection is made to his going with the other section. The average attendance of these after-school excursions is less than half of the class, or section, at one time; but most of the pupils go once or twice in the course of the spring and a few go nearly every time.

A combination of the preceding times may be utilized if the school program is so arranged that the science class under consideration comes the last period of the day.

From these after-school excursions we usually return for supper, but in the long days of late spring we sometimes go by boat and take a lunch along.

The excursions the pupils look forward to with keenest anticipation and remember in after years, are those given Saturdays or holidays. These are announced beforehand, often more than a week before. Sometimes they are for the forenoon only or the afternoon, usually for the day. In some instances, if the distance is great, they extend into the evening. In any case the approximate time of return is announced before the day of the excursion so that the pupils may prepare their lunch and will know whether if they go they will be back in time to meet other engagements. It rarely happens that all but one or two in a class of twenty-five go. In large classes or if the excursion is for the whole high school the number to go is not often more than two-thirds of the whole. It may average two-fifths. Very few biology students miss all of the Saturday excursions. Some go on nearly every one.

TRANSPORTATION.

On the excursions after school we usually go by trolley car, some of the class using their bicycles instead. The distance is between two and four miles. Frequently some who go by car prefer to walk home. Sometimes we walk from the school house to the outskirts of the city. Formerly when horses available for such purposes were not so scarce we would drive several miles after school. Once or twice in the spring we cross the bay in a launch or sail boat.

On the Saturday excursions all of these means have been employed and sometimes combinations of them. The objective points then are usually between five and seventeen miles away, occasionally farther. The electric lines are used most frequently, rarely the steam railroads, often steamboats or naphtha launches. It is a question whether the excursions on the water in fine weather or the drives are enjoyed the most. Fine excursions have sometimes involved a ride of twelve to twenty miles by car and then a drive along a river valley.

EXPENSES.

Reduced rates are usually secured for transportation on the Saturday excursions, lower in many instances than most people ever secure for the

same trips. Boats are often chartered. Sometimes we can use them without interfering with their regular trips. The average expense for each pupil, whether the excursion is on water or on land, is probably not more than thirty cents for the round trip. Frequently it is but little more than one cent a mile by car and less than one cent a mile by boat. Once on a thirty-five mile drive we had about a dozen carriages without hiring any. At another time we were met at the electric car twelve miles from Sandusky by pupils who lived within six miles of the spot and other friends in such number that by hiring one team we were able to take a very enjoyable and profitable drive although there were about sixty of us.

PREPARATION.

Before going on a long excursion I oftentimes tell the class in advance something about the region to be visited or give some instruction concerning subjects of which the region affords fine illustrations. Sometimes I have them copy a list of the things to be noticed,—trees with which they are not already familiar, shrubs or herbs they have heard of but not yet seen growing, birds and mammals they ought to see and hear, geological formations.

A brief list of things to take, depending on season, place, time of return, and main objects of excursion, is useful, e. g., old clothes, rubbers, warm wraps for the return, vasculum or other large box and small boxes for delicate specimens, a field or opera glass and sharp eyes. A small map showing all the roads has been given to each pupil on some of the excursions and they are told to keep them and take them on other excursions, but they usually forget to do so. It is well to have at least one topographic map along, if any exists.

INSTRUCTION.

While on the excursion the teacher should not expect the pupils to be listening to him continually. To several five minute talks at suitable times and places he may reasonably insist on all listening. Besides these he may point out numerous things along the way in such a manner that the majority may either hear him or learn from those that did hear what the things are. The pupils, if not too old, discover plenty of interesting things which they are glad to bring to the notice of the teacher and glad to learn something about either by investigation or from oral instruction. After the excursion, part of the class time may be profitably spent in questioning the pupils about what they saw, correcting false impressions and adding points of interest.

RECREATION.

On the long excursions it is unreasonable to expect that the pupils will devote their whole time to the subjects they are studying. Lunch at some picturesque spot accessible to a good spring or well should be followed by time for rest, during which those who are never tired can play ball or hunt

for snakes or amuse themselves in other ways. Many of the girls will endure the walk better if they have a good rest at this time.

CONDUCT OF PUPILS.

Some have supposed there would be much difficulty in maintaining any sort of discipline among pupils while on an excursion. No doubt some teachers who have made only one or two attempts at conducting excursions have found the responsibility a considerable nervous strain. Pupils, too, who have never been on a school excursion before and who doubt if they will be able to go again sometimes do foolish things. On the other hand excursions afford a fine opportunity for the teacher to instill in the minds of the pupils fundamental notions of the data of ethics. Many of them have failed to learn at home that the test of conduct is whether on the whole it tends both immediately and remotely to the good of the doer and others concerned. Many of them have come to regard parental displeasure the only thing to avoid. It is not hard to teach the pupil that when on an excursion he is expected to have a good time, but he must not destroy property nor do anything else likely to cause serious annoyance either to schoolmates or strangers.

The large excursions I have found most difficult to manage are those in which we make use of carriages. This is on account of the difficulty of keeping the party together. If a pupil drives a horse which he has himself furnished, he is likely to feel somewhat independent. Sometimes it is difficult to prevent racing. The carriage in the lead may take the wrong road and others follow. I have found that much trouble could be saved by insisting that none of the party should drive ahead of the carriage in which I was at the time riding. If the party is small enough to be accommodated by a single band wagon or two or three hired vehicles there is usually no trouble.

Conversation is usually unrestrained except that I discourage gossip and long stories and try to keep the attention up to lunch time and for a portion of the afternoon on the things they are observing. Some pupils find it difficult to keep still during even a short talk by the teacher or to refrain from annoying others at such times. If they prove troublesome on more than one excursion they can before another excursion be denied the privilege of going. I have rarely found it necessary to resort to this expedient.

On many of the excursions there has been nothing to worry about, unless it was the tendency of some of the party when tired to sit or lie on the bare ground and remain there till they caught cold.

It is well for the pupils to understand beforehand that if they go on the excursion they are not to absent themselves long from the rest of the party without getting permission to do so.

An imaginary objection to field work on the part of those who have never undertaken it is that the freedom of the children on an excursion will lead to their taking too much liberty in the school room. Experience does not accord with this apprehension.

Some have observed that while on an excursion the interest of a pupil is likely to be centered in some person instead of the things they are expected to see. This is seldom the case with pupils under sixteen and after that it should not be regarded so objectionable as to prevent the excursion. In one class where I thought certain ones would go after school only because of their interest in other members of the same class, I went with the boys certain afternoons and the girls other afternoons, but this has seldom been found necessary.

BENEFITS.

Without discussing the subjects to be studied on these excursions I will mention a few benefits to be derived from them that might be overlooked—healthful recreation, an opportunity to see and understand many things mentioned in literature as well as in science and especially a love of nature that adds much to the enjoyment of life.

The following sentence is in Felix Oswald's Physical Education: "No domestic events of our later years can efface the impression of the woodland rambles, butterfly hunts, and huckleberry expeditions of our boyhood; the recollection of first outdoor adventures endure like the mountains and rivers of a promised land whose cities have vanished forever."

Three years ago I gave a paper here on "Original Work for the High School Science Teacher." The conclusion of that paper I will give also as the conclusion of this.

The teacher of natural science who would imbue his pupils with the spirit of investigation should not be content to invoke their assistance in prosecuting his own researches. He should inspire them with a love of nature. To do this he must take them into the country. Some teachers whose early life was spent in the country or in a village fail to realize when they begin to teach in a city how meagre is their pupils' experience with the subjects they are trying to teach them. Until I take them into the country some of my pupils have never seen a sheep, a peacock, or a snake. Some imagine that strawberries grow on tall bushes. Many of them have scarcely, if ever, in their lives seen a hill or a river, save sometime, perhaps, from a car window. The expressions, "up stream" and "down stream" are meaningless to them. They listen attentively in the class-room to a description of the characteristics of a lake beach, but when shown a mole hill they are not sure that it is not a lake beach. Nor have they more knowledge of a beech tree. Not one in ten ever saw beech trees until taken to them by their teacher. The same is true of the hemlock, the witch hazel and many other highly interesting plants. Other trees such as the buttonwood and ash they have seen but never had an opportunity to learn to know them. They do not recognize the note of the meadowlark or the kildeer, or know the difference between a chipping sparrow, and a chipmunk.

The burrow of the woodchuck, the chimney of the crayfish, the ants caring for their pupae and for the plant lice, the protective resemblance to their surroundings of the rabbit, of the grasshopper and the whippoorwill.

the protracted flight of the swallow and the quick movements of the king-bird, the singing of the bobolink and brown thrasher;—these things cannot be brought to the school room. Yet these, and not dried specimens, represent life. To fail to give them any knowledge of these things is to deprive them of a source of enjoyment whose pursuit would do more to enrich their lives than any luxuries that money can buy.

MATHEMATICAL CONFERENCE

NON-EUCLIDEAN GEOMETRY.

LOUIS C. KARPINSKI, UNIVERSITY OF MICHIGAN.

Great discoveries have often been made by scientists working in different places and entirely independent of each other. Sometimes the circumstances can be ascribed only to chance, but often times it is the result of the preparation that has been made in the previous years leading to that truth. Four men, each quite entirely independent of the other three, worked out about the same time a system of non-euclidean geometry, or, at least, had the fundamental ideas necessary for the construction of such a geometry. The great Gauss and one Schweikart, Professor of Law in Charkof, recognized some ten years before Lobatschefskij's work was published the possibility of a consistent geomtry in which the sum of the angles of a triangle should be less than two right angles. Neither Gauss nor Schweikart published anything on this subject although Taurinus, a nephew of Schweikart, published in 1826 the formulæ for spherical triangles in which the sides are given pure imaginary values and he noted that these formulæ state the relations existing among th sides and the angles of a triangle in which the sum of the angles is less than two right angles. Lobatschefskij, Professor of Mathematics in the University of Kasan, and Johann Bolyai, Lieutenant in the Austrian army, conceived and developed almost simultaneously this geometry. Lobatschefskij's first works on the subject were published in 1829 and 1830, and Bolyai's one work was given to the public in 1832.

In our present discussion we will follow largely Lobatschefskij. We will give the proofs of a few of the fundamental propositions and we will state a number of the results which are of especial interest to teachers of elementary geometry.

Of the postulates and axioms of Euclid six stand out as essentially geometrical.

1. That a straight line may be drawn from any one point to any other.
2. That a straight line may be prolonged to any length.
3. That a circle may be described about any center with any radius.
4. That all right angles are equal.
5. That two straight lines do not enclose a space.

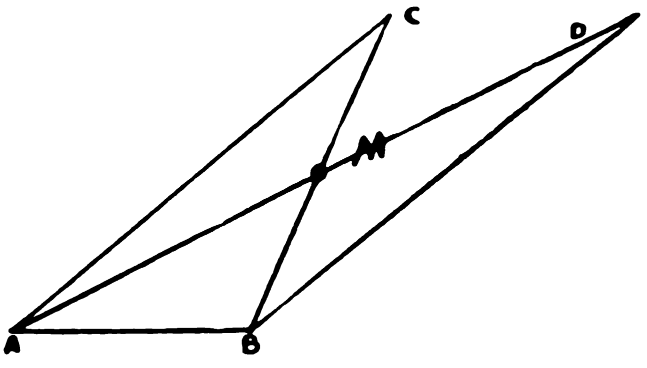
6. **If a straight line meet two other straight lines so as to make the two interior angles on the same side of it together less than two right angles, these two straight lines being continually produced shall at length meet on that side of the straight line on which the sum of the angles is less than two right.**

This is usually given as Axiom 12, but Heiberg and other authorities agree that it is a postulate in the original. It is essentially different than the others. Euclid could have worded it as follows: "That through one point only one parallel can be drawn to a given line," or, "That through any three points a circle can be drawn," or "That the sum of the angles of a triangle equal two right angles." But from the form of the wording and the fact that Euclid does not use this postulate for the first 26 propositions, Book I, we conclude that Euclid recognized the inherent difficulties of any theory of parallels. This stumbling block to progress toward any rigid grounding of the science of geometry was removed only after some 2,000 years of speculation, and now, indeed, has become almost the headstone of the corner.

It is of some interest to note that as early as the fifth century Proklus criticized Euclid's postulate and wished to substitute for this that two lines that are everywhere equi-distant are parallel. Attempts to prove the postulate were numerous in the twelfth and thirteenth centuries among the Arabs, and in the seventeenth and eighteenth centuries in England, France, and Italy. Saccheri, an Italian, 1667-1733, and Lambert, a German Swiss, 1728-1777, made the greatest progress in this work, developing to a large extent the work completed by Lobatschefskij and Bolyai

We will demonstrate two fundamental propositions.

1. That the sum of the angles in any triangle equals or is less than two right, the straight line being assumed infinite in length.

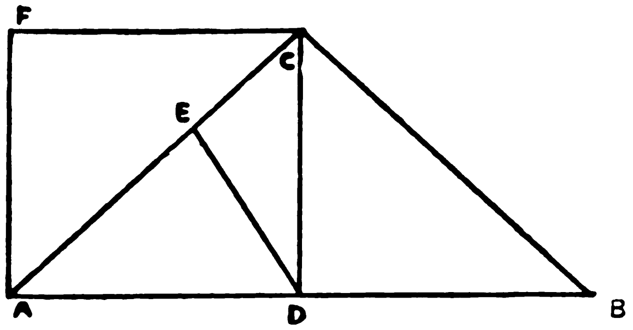


2. That if in any triangle the sum of the angles equals two right angles then in every triangle the same holds true.

Let ABC be any triangle and A the smallest angle. Through M, mid-point of BC, draw AMD, making MD equal AM. Connect D and B.

Triangle MBD equals triangle MCA. Sum of the angles of triangle ABD is same as of ABC and angles DAB and ADB together equal angle CAB. Take the smaller of angles DAB and ADB and repeat operation—suppose it DAB. Then DAB is less than $\frac{1}{2}$ CAB. Next angle D^1AB is less than $\frac{1}{4}$ CAB and so on. Assume the sum of the angles of the triangle equal 2 Rt. + α. We can continue operation until sum of the smaller angles is less than α since it is less than $\frac{1}{2^n}$ CAB, and therefore the sum of the angles is less than 2 R + α.

∵ Sum of the angles of any triangle is less than two right angles or equal to two right.



Suppose sum of angles of A C B equal two right. Then any triangle cut off as A D C also contains two right. Suppose A D C has angle sum equal 2 R — x, then D C B equals 2 R — y and 2 R — (x + y) = sum of angles of A B C equals two right.

∴ x + y = o, and x = y = o as both x and y are positive. Similarly A D E. Also the right triangle A D C has angle sum two right and rectangle A D C F can be built. Any right triangle can be included in a larger rectangle built up from such small ones.

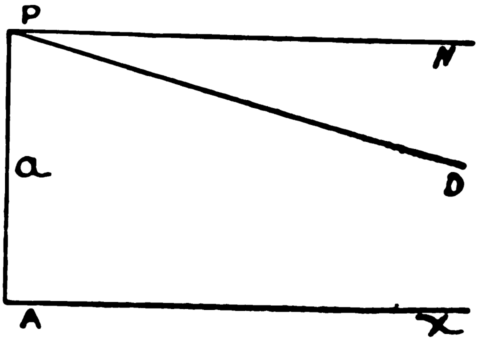
∴ Sum of angles of any triangle equals or is less than two right angles if it is so in any one triangle.

A proposition which follows quite simply is that two triangles in which the sum is less than two right are congruent of three angles of the one are respectively equal to the three angles of the other. Also that two triangles whose angle sums are equal are equivalent in area.

Given any line of length a and A X perpendicular to it. Then it is certain that through P one line can be drawn which does not meet A X, viz., the perpendicular P X to P A at P since if this met P X we would have a triangle whose angle sum is greater than two right. In passing from P A to P X by rotation we pass from lines that cut A X to lines that do not cut and suppose P D the first line which does not cut A X. Then in our new terminology we will understand P D to be the parallel to A X. It is evident that there is another parallel similarly situated on the other side making

angle A P D' equal angle A P D. This means that the line has two points at infinity (in different directions). The angle A P D is called the angle of parallelism for the distance a and is designated by π (a). In the usual sense of parallels we see that there are an infinite number of parallels to the line A X on the side X, viz., all the lines between P D and P N.

If we assume that the sum of the angles of a triangle equals two right angles we can show that then only one parallel is possible. It follows that in our new geometry the sum of the angles of a triangle is less than two right angles. It is easy to prove also that if two lines which meet a third so as to make the sum of the interior angle equal two right are parallel then the sum of the angles of a triangle equals two right. It is evident, then,



that Euclid's assumption is equivalent to the assumption that the sum of the angles of a triangle equal two right, or to that two such lines as given above are parallel.

Somepropositions evident in Euclidean geometry must be demonstrated in the new geometry. If P D is given parallel to A X it is necessary to prove that A X is parallel to P D. Also that two lines parallel to a third are parallel to each other.

The angle of parallelism is dependent upon the distance a, and grows smaller as a grows larger, varying from $\frac{1}{2}\pi$ to π'.

There are no similar triangles and propositions based upon proportion must be restated.

The sum of the squares algebraically of two sides of a right triangle is less than the square upon the hypotenuse.

There are no squares and rectangles in a geometric sense—else there were triangles whose angle sum would be two right.

The perpendiculars erected at the middle points of the sides of a triangle may meet in a point, otherwise the three are parallel among themselves or all three are non-intersecting lines.

A circle with infinite radius is not a straight line in this geometry but is a boundary curve. Any two parallels to an axis of this boundary curve are equally inclined to their chord of contact. A boundary surface is obtained

by revolving such a curve upon one of its axis and on this surface Euclidean geometry holds.

The trigonometric formulæ must be largely modified. We have in a right triangle, c being the hypotenuse,

$$\sin \pi(c) = \sin \pi(a) \sin \pi(b).$$
$$\cos \pi(a) = \cos B \cos \pi(c).$$
$$\sin B \quad = \cos A \sin \pi(a).$$

in which π (a), etc., are the angles of parallelism as before defined, and A, B, C the angles opposite sides a, b, and c.

In the general triangle we have ch a = ch b chc — sh b shc cos A wherein ch and sh stand for the hyperbolic cosine and sine. This formula corresponds exactly to the change from x to ix for the side of a spherical triangle in the ordinary form.

Cos a = cos b cos c + sin b sin c cos A, in which cos x and sin x are defined by

$$\frac{e^{ix} + e^{-ix}}{2} \text{ and } \frac{e^{ix} - e^{-ix}}{2i}$$

Any right triangle and any quadritatual having three right angles can be constructed with compass and ruler when two other elements are given. These constructions were touched upon by Bolyai and further developed by M. Gérard and M. Barbarin. The formulæ for the areas of given curved surfaces and volumes of solids have been derived.

In this geometry we assumed the straight line infinite in length. By which the sum of the angles of a triangle is greater than two right angles. An illustration of this is the geometry on a sphere.

We can construct surface which plays the same rôle with respect to the Lobatschefskijan geometry as the sphere does above, viz., the surface generated bythe tractrix revolving about an axis. This is a surface of constant negative curvature and all the constructions of the new geometry are possible upon it.

Certain propositions of this geometry can be well interpreted by figures on an imaginary sphere, *e. g.*, the area of a triangle on a real sphere equals r^2 (A + B + C — π) or is proportional to the excess of the sum of the angles over 180° and making $r = r\sqrt{-1}$ this becomes

$$r^2 \left(\pi - (A + B + C) \right.$$

which states that the area of a triangle is proportional to the deficiency of the sum of the angles from 180°.

There is an immense field of literature on the subject, largely in German and French. In English there are, among others, the following:

Professor H. P. Manning's Non-Euclidean Geometry.

Bolyai's Non-Euclidean Geometry and Lobachevoski's Non-Euclidean Geometry, both translated by Professor S. B. Halsted.

In German especially good, are the works Urkunden zur Geschichte der Nichtenklidische Geometric by Engel and Staeckel.

CERTAIN ASPECTS OF THE PRESENT TEACHING OF SECONDARY MATHEMATICS.

C. I. PALMER, ARMOUR INSTITUTE OF TECHNOLOGY.

Someone has remarked: "It is generally conceded that mathematics is one of the best taught subjects." Is this true? If so, what are we to say of the other subjects? It is not the purpose of this paper to answer these questions, but to set forth some few ideas and observations, and more existing facts regarding the present teaching of mathematics. In doing this I trust I shall be pardoned for speaking in some detail of the work at Armour Institute of Technology.

Much, very much, indeed, has been written and said in the past few years, concerning laboratory methods in teaching mathematics. How we should use this experiment or that one, or make use of some complicated piece of apparatus in the mathematics class room. Many have theorized upon what should be done, but have never done anything. Their ideas may be good, but are of small value to the teacher. Others have written of exactly what they have done, and how they did it. From such a leader the teacher can get something.

Huxley has said that, "Mathematics is that study which knows nothing of observation, nothing of experiment, nothing of induction, nothing of causation." Some still hold to these ideas, and teach accordingly. But most of us, in this section of the country at least, see much in a close correlation between the different branches of mathematics, and the subjects of physics and mechanics.

The translation of physical and other facts into mathematical terms is one of the most important duties of the teacher of mathematics. The laboratory methods make this possible to a great degree.

It also makes possible and gives many opportunities for the use of mathematics, and gives to the thoughtful student an insight into its further uses. He sees that mathematics is a tool, and a powerful one, which gives the possessor advantages according to the fullness of his possession and ability to use.

Be not carried away with the beauty of the idea. Teachers have made this mistake too often. We are too apt to give out work in a sugar-coated form. Much of the experimental work is of this nature; the pupil is amused and entertained by the instruments and devices used. He does not get from the experiment what we see in it, and expect him to get from it. It amounts to about as much as does the measuring of saw-dust and sorting of tooth-picks when guided by an inexperienced and thoughtless teacher of the lower grades. As a bright boy in algebra, who was disgusted with his knowledge of arithmetic said, "When I was in the seventh grade we spent most of our time in handling blocks and bundles of tooth-picks." The point I wish to make is not that the laboratory methods

should be done away with, but that, perhaps, less should be attempted, and more careful thought given to what we do. Especially let us not lose sight of our algebra or arithmetic or geometry, or whatever we really have in hand.

What shall be the test of an experiment? Try this, if a problem involves a technical knowledge of another subject, and this knowledge cannot be given without detracting from the subject being taught, then this problem and the mathematics of it belongs to the other subject.

The pendulum is vibrating farther in some schools, and communities, than in others, but this is always true. Text-books have been discarded and adopted. First this method is all wrong, and then suddenly is accepted. Perhaps I can best show the present state of affairs by speaking of the conditions in the Armour Scientific Academy. Changes have been made, and are now being made—the pendulum is vibrating.

In the first year's work, which is that of the first year in the high schools, changes have come. Some two years ago we endeavored to do some geometrical construction work in the last term of the first year, besides covering the subject of algebra through quadratics, ratio, proportion, variation, progressions, and logarithms. Last year the geometrical construction and all the algebra past quadratics, except ratio and proportion, were left out of the course, and this year it is very doubtful if we do anything with ratio and proportions.

There are at least three reasons why these changes have been made. First, since our chief aim in the academy is to prepare students for the Institute of Technology, we are especially anxious that the preparation shall be thorough. In one year's time we have found that we could not do more than the necessary work through quadratics and master it for the algebra part of the year's work. Secondly, since each year and even each term we are receiving pupils from other schools, it causes more or less trouble in adjusting them if we are doing work very much different from other schools. This is the chief reason why we do not now touch logarithms until we are teaching trigonometry. When the students we had trained understood logarithms, and the subject had to be presented to nearly all others, the classes became somewhat demoralized, and it was easily seen that we were not working to the best advantage. For we argued that if we had to teach the subject twice when taught first in algebra, and only once, if taught first in trigonometry, it was obvious that time would be saved if the subject was presented first in the latter subject. Then, too, from the standpoint of teaching a thing when it is necessary to know it because needed for use, the decision was a sound one.

The third reason, and one in which my observation has not been as extensive as I wish it had, is the poor preparation in arithmetic of students on entering the Academy. My own observation and experience, and that of others, leads me to believe that the pupils, especially from the Chicago schools, are less well prepared in arithmetic than formerly. This year, for instance, out of a class of nearly one hundred pupils in the first year class

in the academy, about eighty-five per cent were found to have no idea whatever, or else a very crude notion, as to the placing of the decimal point in multiplication and division of decimals. This is given as only one of many faulty operations observed. It might be mentioned how some could not add and subtract the most simple fractions, or how still fewer could not divide 2/3 by 3/4.

The teachers of physics and chemistry in the Armour Scientific Academy state that one-half of the students who fail in these subjects do so because deficient in arithmetic knowledge. As an illustration, the majority when given the formula for the volume of a cylinder, $V = h \pi r^2$, and given the values of h, π and r, could not accurately find the value of V.

The accumulation of facts as to the preparation in arithmetic has forced upon the department of mathematics the teaching of arithmetic. We looked into the question carefully and decided against putting in a special course in arithmetic to extend through say one term. It was thought best to do some systematic work in arithmetic through the two years given to the study of elementary algebra, and plane geometry. We then prepared a pamphlet of problems, such as we considered best suited to bringing out the points we wished to emphasize, and in which the pupils were deficient.

These problems consist of many examples where operations alone are emphasized. Others have to do with metric and English measures. We included very many problems where substitutions are made into physical and geometrical formulas, and such as occur in chemistry. Some of these problems are assigned on nearly every day to be solved and handed in. An answer correct to a certain number of decimal places is required instead of a surd form, and the work is carefully criticised as to form and method. I might state here that all our problem work in mathematics is handed in and inspected, each instructor having a student assistant to help in this. Every few days at least a part of a recitation is spent in arithmetic. This arithmetic work is only just begun, but we hope to find that it will overcome the deficiency now so manifest. I should like to advance right here some reasons why the students are so poor in arithmetic.

It is generally conceded that there are two reasons for the teaching of arithmetic: (1) to develop skill in the handling of numbers and a practical knowledge of them; and (2) to train the mind to right thinking. Some years ago there was a marked change in teaching of arithmetic. The Speer method was put forward and every teacher was looking for something new in the way of method. The subject was made interesting, and the pupil's wishes and not his needs were consulted. As was stated by one of the prominent teachers of arithmetic in Chicago seven years ago: "The processes to be taught in arithmetic should be determined by the child and not by the educated teacher." And further, "Teach no part of arithmetic mechanically."

The result of all this was that the pupil had a merry time, but learned very little arithmetic. We are now just far enough removed to be reaping

the full benefit. The pupil's mind may be as well developed in analysis, but the practical work with numbers has been sadly neglected, and what we may call the mechanical part of the work is very crude. But when all is said and done, we have to deal with these pupils. They must be prepared to do the mathematical work in their physics and chemistry. However, we hope and trust that the training in arithmetic in the future will be better than that of the immediate past. It is not the function of this paper to outline how this is to be brought about; but allow it to be said that it will probably come about in part by the use of more sanely prepared text books than many of those now in use; and by a less scattering of the ideas while pursuing the subject. As Dr. David Eugene Smith says: "Of late we have been letting arithmetic slip from our hands because we could not justify the general arrangement of the books so at variance with our present life. That better computers were produced forty years ago than now was not owing to the dull rules, the stupid principles, and the absurd problems of that day; but because the work was definite, the teacher and the pupils could get their bearings, the curriculum was confined to the 'Three R's,' and this particular 'R' had its share of the time. Make the new arithmetic as definite as the old, preserve the best of the topical arrangement, give enough problems and let them appeal to the common sense business man as genuine, and to his child as interesting, and the arithmetic of the future will be the best that the world has ever seen."

To return to algebra, what we need is not to train the pupil to juggle with the equation, but to train him to recognize the relations of things. The equation should mean something. Any means or device that will aid the teacher in showing the meaning without causing the pupil to lose sight of the subject is legitimate. Use balances, drawings, discuss meaning, give definition, illustrate physical meaning, do anything which you as a skilful teacher can; but be very careful that the attention of the pupil is not taken from the equation, and that he does not think he is only measuring saw-dust.

Solve problems often in the abstract, and pass to the concrete. Require pupil to state result in words, and tell physical meaning. Work carefully to lead him to see that we can thus make rules, and find results from given data. The comprehension of the physical meaning of formulas can be made clear by thus translating them.

Dwell upon fact that much of our language of mathematics has come about by agreement and convention; *e. g.*, the meaning of exponents, and the method of expressing varies as.

In our courses, just as when we are teaching algebra, we make everything else subsidiary; so when we are teaching a certain subject of algebra, that subject is in the lime light. But this does not prevent us from constantly recalling other subjects. For instance, when we are at complex fractions in particular, factoring and equations may be in the assigned lesson. In our review algebra when taking factoring, we always solve quadratic equations, including the most general case, and do it by factoring, which, of course, requires the factoring of $ax^2 + bx + c$, and in particular cases

involves surds and imaginary expressions. Much is made of the remainder theorem and its use. The formulas of physics are introduced and the notation of these is used instead of using only the staid old letters a, b and x, y, and z. Not only are numerical values substituted into formulas, and accurate results required; but a few explanatory remarks are given, and in some cases formulas derived. In other cases certain forms of a formula are given and other forms deduced. Much of this we have in mimeograph form. While we do not actually spend time during the first year in making geometrical drawings, we use much of geometry. The facts regarding a right triangle and other forms in plane geometry, as well as those of cubes, cylinders, etc., are known or readily developed. Problems are solved which involve these facts and principles.

In plane geometry, which continues through one year, we use the heuristic plan in demonstrations. A text book* is followed somewhat closely, but it is one in which all the proofs are omitted. The instructors are all unanimously in favor of the text. Better results are obtained with it than we have ever secured with the common text. This is especially noticeable in the pupils' ability to attack a new problem, and make something of it. He has developed initiative. The use of this text requires some more time on the part of the teacher. In particular at the beginning must the progress be slow and sure. Much construction and some of what might be called laboratory work is done from the beginning. Each pupil is required to secure a note-book, protractor, compasses, dividers, rule to metric and English scale, squared paper, and a hard lead pencil. He is given work in comparing the two systems of measure, construction of angles, triangles, parallels, and numerous other problems. Vector numbers are discussed and used in finding composition and resolution of force and velocities. Sines, cosines and tangents are used to some extent. Much use is made of algebra and thus it is at least kept in mind during the year devoted primarily to geometry. Many problems are solved involving algebraic equations, simple, quadratic, and simultaneous. Problems of computation are used where the results to a certain number of decimal places are required. And do we not secure better results when algebra is thus taught with geometry than when the two subjects are made co-ordinate for say the two years?

Solid geometry is studied for the term of three months. Much is made of the subject of loci, and the generation of surfaces and solids by revolution of lines and surfaces. In this connection algebra is constantly used, and the ideas so useful in the more advanced mathematics are engendered. A great many of exact computations are required here, and many of the least useful theorems are omitted.

Trigonometry is the subject above all others of the secondary courses in which the pupil realizes that he must use the very best that is in him.

* The text used is [illegible] Plane Geometry

But few students do the Freshman work in the College of Engineering until they have taken trigonometry in the Academy. So true is this that most students who have studied trigonometry elsewhere take it over in our classes when entering college. The particular parts which are of most use in analytical geometry, calculus, and mechanics, are made the subjects of most careful study. Logarithms are first taken up here, and much time is given to evaluating of forms which arise in calculus and mechanics.

It is seen, then, that at Armour Institut of Technology a very close correlation is made between arithmetic, algebra, geometry, and trigonometry; and that the relation of all these courses with physics and mechanics is a reasonable one. In its turn each subject in mathematics is in the lime light, but not to the exclusion of the others from any consideration. Much of what may be called laboratory work is done, but not so brought forward as to cause the student to lose sight of the mathematical subject in hand. We constantly keep in mind that we are preparing students primarily for a course in engineering. This forces much emphasis being laid upon accurate computations and the practical side of the subject.

If it were not outside the sphere of this paper, it could be shown that just as close, if not closer, relations exist between the corresponding branches in the College of Engineering of Armour Institute of Technology. Perhaps we have an advantage over many schools. In many ways the conditions are ideal. Close and cordial relations exist between the different departments. The same instructor in mathematics may be asked to teach any subject from elementary algebra to mechanics in the Junior college year. Each one thus knows exactly what comes before his subject and also what is to follow to the end of the line. He knows just what to expect to be well understood, and what to lay particular stress upon.

In the foregoing a simple statement of facts and work being done is given. Nothing is done in Armour Scientific Academy that could not be done in any first class high school. We may tend toward the conservative, but we honestly believe that we get results. The corresponding work at Bradley Polytechnic Institute at Peoria, Illinois, and Lewis Institute, Chicago, is very similar and they too believe they are accomplishing excellent results.

ENGLISH CONFERENCE

No formal papers were presented, but teachers met for presentation of difficulties and for free conference on methods and aims in co-ordinating and conducting the various branches of the work in English Composition and Literature.

HISTORY CONFERENCE

PRINCIPAL WEAKNESSES OF FRESHMEN IN HISTORY, WITH SOME CONSIDERATION OF THE REMEDY.

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Among the students in our introductory work in history there are now and then those whose unsatisfactory work may be due to some physical ill: their pale face, or hollow chest, or languid air possibly accounts for their small achievement. At all events they are entitled to suspense of judgment, until some physician may have given them a fair chance with their fellows. Others, again, are simply mentally unable, their birthright of mind being —pathetic to say—but as a mess of pottage. No other diagnosis tells why one who has been at work on the middle ages for six or eight weeks should seem really puzzled when told that the Mediterranean was not the Holy See; or how a student who had been over the same course twice, and had really worked, could then write of the Arian-Athanasian controversy that "In the fourth century there were two great parties in the church, the Arryans and the Athenians, who differed on all subjects but one—they agreed that gesus was a son of god." For such unables there can be no solace, save that which lies in the bliss of ignorance.

But if we eliminate these two weak classes,—the physically ill because they are provisionally negligible, the mentally unable because they are hopeless under any circumstances,—there remains with us a third group of defectives: those who are sufficiently endowed yet cannot utilize their latent powers, persons who are really susceptible of education but whose minds and souls are not developed in any measure befitting their years. Just what percentage of those who elect our introductory course belong in this group it is impossible to state; but it is true that they are enough in quantity largely to determine the quality of the entire class. These are the students I have especially in view now. To set forth the principal defects, or weaknesses, they show may prove of service to those in charge of the work of the schools; since while what is said may contain little, or possibly nothing, that is new, nevertheless a plain statement of some conclusions drawn from several years' experience with college freshmen may focus attention upon

certain deplorable characteristics of many of them which, it would seem, might be at least partly removed by improvement in the preparatory work.

Possibly the most fundamental weakness prevalent among such students is that they lack the habit of having accurate knowledge. I do not mean simply that they have no accurate knowledge on this or that question which may be propounded to them; any one may easily find himself in that condition. I mean rather that they are not accustomed to know much of anything in an accurate way; that it is not a habit with them really to know even that which they are willing to profess to know. At the end of a week's work on the Germanic invasions of the Roman Empire, they may not be able to give an exact account of a single step or event in the career of any one of the invading peoples, or know that the Huns were not Germans; and yet they may be quite ready to talk about the Visigoths or the Vandals for five or ten minutes. After laboring for some time over the reform movement that centered in the monastery of Cluny, they are likely to write, not without fluency, about the reforms of Mr. Cluny. One of them—or possibly this person should be enrolled with the unables—has stated that "Islam was probably the first real man to think along the lines of Mohammed." Another recently gave out the remarkable information that "When we speak of the Slavs we mean the race or peoples that lived on the south shore of the Mediterranean. The Slavs were dreaded invaders and it was thought they were pretty strong. By the times of the crusaders they had gained some footing in Italy and Africa, and after the first crusade had started, they had taken a part in taking Syria as the ones did that stopped at the town opposite Syria." One special characteristic of the unscholarly youths who say such things is their apparent inability to get out of a sentence or paragraph what it really says. Have them read a paragraph or two on Justinian's codification of the Roman law, and supplement that with a half hour's explanation of just what Justinian had Tribonian and his colleagues do; then several of them will be ready to tell you that Justinian was the *author* of the Roman law. Place before them a clear explanation, not a page in length, of the origin of the "Forged Decretals," and I hesitate to say how many will fail to see from it just what gap these documents were designed to fill.

It is not that such students are not interested, nor simply that they do not work enough. Under either of those conditions, the phenomena in question might be adequately accounted for without going farther back than the University course in which they occur. Doubtless it will always be possible in the University as elsewhere to improve the treatment of this or that subject, so as to arouse greater interest and secure more effective work. But with the ways of treatment followed so far, such students are frequently profoundly interested; it is not uncommon for them to work much, and with enthusiasm. Their mental activity, however, is apt to take the form of discussion rather than knowledge. They will reason about the matter in hand, and consider with veritable avidity what might, could, would, or should be;

but at the same time they will avoid facts as they would poison. Sometimes they will seem all but to consider it an insult to be asked for definite, specific information. In sum, what many students of capable endowments are able actually to know, when they first come to us, and to tell to others so that they also may know it, is so little that it is hardly respectable. They need to talk but a moment before one is compelled to question how they have done their work in previous years, whether they have been trained to do much of anything thoroughly.

A second fundamental weakness among the students whom we are now considering is that they have too little ability to make use of facts, once they get possession of them. If perchance they learn definitely that there was a battle of Adrianople and exactly between whom and when it occurred, they are quite apt to know nothing of what led up to it, or to have no definite curiosity about what significance it had either for the Roman state or for the Visigoths. If they learn to spell Attila's name—I have known one student to spell it four different ways within five lines—and to know that after Attila's time the Huns achieved little in Europe, they still fail to ask, to say nothing of understanding, so simple a question as just how did the great leader's death affect the fortunes of his people? Or they will learn conclusions, make statements of greater or less generalization, and have not the slightest evidence for them. One of our hardest tasks is to develope in them a realizing sense that such a statement as "Charlemagne conquered much territory" demands in proof specific mentions of at least some of his conquests; and quite frequently it is a case of developing, not a realizing sense, but simply a mere acquaintance with that habit of mind which calls for proof. Such students will tell you that Philip Augustus greatly extended the royal possessions in France, and then if asked what evidence they have of Philip's success they will say, not that he gained Normandy and Maine, among other lands, but that they read it in a book. If asked what facts bear out their statement that Charles V of Germany acquired many regions by inheritance, they will possibly offer one or two irrelevant observations, sit down with an air of surprise that you should be so cruel, and tell their friends that you ask such funny things. Clearly the art of asking historical questions of facts—I do not mean asking them of documents primarily, but of the facts to which documents bear witness—this art is none too much cultivated in the circles in which many of our freshmen move before they come to us. And yet this art, practiced until it is a habit, is the indispensable means of making knowledge of facts worth while. Without it no one can attain the higher ends of the study of history. Without it no one can know in an understanding manner where we now are with our states, and literatures, and religions, and what not, and in what direction we are moving. Without it no one can ever cultivate, in any true sense, his judgment of cause and effect "as cause and effect take place in human affairs."

These, then, are the principal mental ailments our freshmen in history are heir to. If I mistake not, the other shortcomings they exhibit, such as

poor spelling, slovenly writing, inadequate vocabulary, talking off the point, and the rest, would all but disappear were each student but sufficiently grounded in the habit of knowing his facts accurately and in the equally essential habit of putting them together in a manner to reveal something of their historical significance. Furthermore, after patient observation of their habitual shortcomings, after a conscious and persistent but none too successful endeavor to reduce their lapses in knowledge and understanding to what might seem normal frequency, especially after often all but sacrificing other aims of college work in order to fight the plague of inaccuracy, the instructors in History 1 and 2 at the University feel justified in the conclusion that at least a considerable share of the responsibility for such conditions rests with those who direct the work of the schools.

But if it be granted that improvement of the preparatory work would help much to remove the primary causes of our troubles, just how may we expect to secure that improvement? To begin with, in what measure should we depend for it upon better means with which to do our work? Certainly there has been in late years much improvement in the means for the study of history in the schools, and progress in this regard is still going on. Any teacher whose experience goes back over a decade, or even half a decade, knows that he has much less reason now than formerly to complain of the text-books. These aids have not only increased in number and kind, but as a rule are better in quality. Thanks to the combined labors of historical scholars, historical writers, and practical teachers, they are now numerous and varied enough to accommodate different grades of work and different tastes or local demands among teachers and schools. And with better text-books have come numerous other aids; appropriate collections of sources, teachers' guides, in some places special libraries for collateral reading, better maps, and illustrative pictures. Yet I, for one, am distrustful of expecting too much from our acquisition of better tools. To be sure we have right to think that, other things being equal, we can do better with modern machinery than with the antiquated mechanisms employed by a preceding generation. Wheat, of course, can be separated faster with a thresher than with a flail. But after all, if we are to seek renewed strength primarily in improvement of the tools we employ, I am convinced that the fundamental weaknesses which now exist will always be showing themselves in undue proportion. We must look chiefly, I think, to the persons who are using the tools; to the printer rather than to his press. One can easily comprehend that the finest printing presses would not profit much in the hands of a Hottentot; but it seems just as true, though not quite as easy to see, that good text-books and plenty of collateral reading are of little avail in the employ of an unfit teacher. It seems to me as clear as day—and every one here will surely agree with this—that no one who is not himself imbued with the spirit of accuracy and thoroughness can inspire such a spirit in the young. And in like manner, he who learns by rote, and has not the habit of inquiring into the significance of things, can never train others to ask of thoughts and of deeds

and of events what led to them and what they in turn led to. So, better the tools as we may, in last resort, our salvation will depend on those who use them.

The truth is, indeed, that with all their recent improvement, the principal tools at our disposal,—that is, our text-books,— are of such character that the teacher in history has a greater measure of responsibility for what is to be done by pupils than has the teacher, if not in any other subject, certainly in most other subjects of the curriculum. The manuals in algebra and geometry hold between their own covers the matter which is counted essential for the subject and grade to which they apply. The first-year books in Greek, Latin, German, or French supply material that is definite—even graded—throughout, and they are adequate enough of themselves to give need only of a grammar besides. The manuals in physics and chemistry call for much supplementary work in the laboratory; but the principles they set forth are limited in number, are especially susceptible of definite statement, and by experiments may be actually seen, or touched, or smelled. The personal factor necessary in the successful teaching of a piece of literature can hardly be exaggerated; yet the Cicero, or Virgil, or Shakespeare that is read in class is fully printed out on the page that lies before both pupil and teacher. Our history text-books, on the contrary, do not contain in any such clear and unmistakable form the matter that we ought to teach, and that our pupils ought to get. Whether they should or not, as a matter of fact they do not. I know of no one of them, at least in European history, that is written as history is best written. Not more than one of them so restricts the number of questions it treats that it has space always to set forth evidence as well as conclusions. Only rarely, not customarily, do they bring into the light reflected by broad statements the details of human life, the actual thoughts and deeds of the men in view. They are, even at their best, but guides, bearing somewhat the relation to history that histories of literature bear to literature. And unless the teacher who uses them is able to go to the history to which they guide, his pupils will have as much reason for execration as those unfortunates who are dragged or whipped through some Crutwell or Shaw, without time and without a cup to drink from the springs that well along the course, just out of reach.

I run the risk, however, of merely expressing a commonplace if I only insist that the chief hope of a reasonably efficient remedy for the defects of our preparatory work lies with the teacher rather than with the books he uses. That is altogether fundamental, you may say, but quite evident. The fact is, it is like the golden rule, and other such principles set forth in the Bible: the rub comes not in knowing it but in applying it, not in accepting it but in seeing just how to live up to it. Is there, then, some plain course to choose, which when sanely followed surely leads to increasing effectiveness in teaching? Is there some particular, definite aim, the faithful, wise pursuit of which will not only keep him who is teaching on the

right road but insure at the same time that the pupils following after him arrive at a worthier goal than many of them reach now? These questions, I think, must have an affirmative answer, if we but recall that, in the last analysis, the processes which are fundamental in the teaching of history are first fundamental in the writing of history; just as the course of thought followed in teaching how to build houses, or bridges, or what not, should first prove safe in the actual building of such things; or just as the methods followed in classes in painting must first hold good in the making of pictures.

Now he who takes part in the writing of history is necessarily occupied in one or the other of two ways: he does something either upon the immense task of establishing facts or upon the still more immense task of treating in a historical way facts that are already established. If he has good principles, before he engages in putting facts together to reveal their connection and historical significance, he aims to know the facts he works with. Whether he establishes these facts himself, or accepts them as established by some one else, he endeavors to have, with reference to any given matter, a clear, appreciative, objective knowledge of just what persons or people were concerned, just what was thought, or said, or done, and just when it happened. Not until he is thus equipped can he safely undertake to tell the true relations of things, the whences and whithers of the thoughts and acts he has in view. On the other hand, once he knows some facts it is incumbent upon him to try to interpret them historically, if he would gain the real fruit of the historian's work. He must go on to trace if he can what they grew out of and what they grew into; for in the measure that he stops with unrelated knowledge will his knowledge be of little power. But the point now is, are not they that are thus occupied,—they, namely, who actually practice the science and art of history,—are not they the persons whose principles and ways of work every teacher of history should have constantly in view? Are they not carrying on, in a manner to be the guides of others, those very processes which should be as paths of life in historical classes? Where indeed may the teacher of history better go to develope independent and trustworthy mental customs, to cultivate the scholarly habits of knowing things accurately and understandingly, than to the great school conducted by those who do historical work? I for one shall expect to see the work in history classes improve in about the proportion that those who direct those classes become real doers of historical work.

This doing of history to which I refer does not mean necessarily that we should all be trying to write a great book, like Mr. Green's *History of England*; nor that, on the other hand, fault of material or equipment with which to do the big things, we should all turn to seeking out obscure facts, say of local history. Circumstances should determine what each of us should be doing. It may be that many of us should occupy ourselves all but solely in patient study of the models of the masters, as the art student who places his easel week after week before a Holbein or a Rembrandt. Or possibly we should be gathering, from different quarters, already established

facts upon some significant person, or idea, or condition, or event; with the purpose, after knowing such facts, of trying our hand at putting them together in a historical way: the tasks in this direction that may be undertaken with profit are, and doubtless always will be, innumerable. Possibly again, some of us should be spending considerable time in searching for facts yet unknown, with which to enrich the present store of knowledge. In any case, whatever our individual needs or tastes, would it not advantage each of us always to have in hand some definite bit of historical work? Thus we might constantly give to our activities as teachers not only trustworthy principles, but also the refreshment and vigor that come with exercise and creative effort.

In conclusion, if it be clear that our University freshmen show in their work in history that too many of them are weak in the scholarly habits of knowing accurately and understandingly, and if also it appear reasonable to attribute a considerable share of the responsibility for such weakness to those who direct the preparatory work, it still may seem that the remedy here advocated is so difficult and slow that to contemplate it is only discouraging. Slow it undoubtedly is. But the changes in human things that are strongest and have the longest life are not those we enact suddenly, but those that grow, those that we cultivate from one generation to another. Moreover, there are indications that the application of this remedy is already well begun among us. The schools insist more and more generally that the teacher in history shall be properly qualified for his work; the historical departments at the University have organized courses which give to undergraduates increased opportunity to get practical experience in doing historical work, and the elections in these courses are constantly increasing; some students remain in the University for a year or more of graduate work, others return for study after a few years; many teachers attend the summer sessions of the better universities; these phenomena, among others, mark a strengthening tendency among us to be ourselves expert in that science and art which we would impart to others. And I for my part refuse to be discouraged. I look rather with confidence toward the day when we all who are teaching history shall be first, in an appropriate sense of the phrase, doers of history.

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MODERN LANGUAGE CONFERENCE

THE ESSENTIALS OF GERMAN COMPOSITION

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Where is the modern language teacher who does not groan, audibly or inwardly, at the very mention of composition, or who has not done so at least at some stage of his or her experience? And the cause for such a manifestation of discomfort is not far to seek. Of all features of the work in Modern Languages, the teaching of composition is the most laborious and nerve-wearing, giving the smallest results for the greatest expenditure of energy and patience. It is the most difficult subject in which to obtain and hold the attention of the learner, to arouse even a semblance of enthusiasm on his part. The pupil approaches the task with a listless, indifferent air, does the prescribed work as carelessly and as infrequently as the watchfulness of the teacher will permit, makes the same errors with maddening precision of recurrence, and meets all reckonings of his shortcomings with an air of injured innocence which in itself blights all hope of future improvement. In brief, composition means drudgery for both teacher and pupil, the teacher, however, being the greater sufferer in proprotion to the conscientiousness and high ideals he brings into his calling.

The reason for this distressing state of affairs may not be so remote or so intangible as is generally supposed. I believe it lies in the disregard of the essentials underlying the *teaching* of composition, for in no other feature of our work is the wise guidance and judicious help of the teacher so necessary. I am more than ever convinced of this since examining an interesting collection of statistics recently obtained. It is an accepted theory that pupils greatly dislike all composition work. To my surprise I found that it is not so much the dislike of the work itself, as the disinclination to spend the required time upon it, that makes it irksome. "It takes so much time,"— how to remedy this almost universal complaint, is indeed the question. For the trouble does not lie in the length of the assigned task, it is far more deep-seated, it lies in the spirit of the times, a disinclination to devote the time and patience necessary to do any task well. The "get-rich-quick" methods have invaded not merely the world of finance. Then, too, another secret and often unconscious reason is stated by a pupil who writes: "I do not like composition work because it shows so plainly what I do not know. In reading or translation I can make a better showing with less labor." So there is evidently a need of developing a moral sense for honest and thorough work. A further point brought out in these statistics is, that the kind of composition work has a strong influence on the mental inclination to do it. If pupils have tasks which they believe to be *practical*, they will do them willingly and even gladly, for they are indeed children of the age. Of

course, the pupils' judgment is not always a safe criterion, but we, with our wider experience of life, our authoritative position, can do not a little to bias such a judgment in the right direction. Errors in composition are often a discouraging element to the learner. Yet nine times out of ten such errors result from heedlessness rather than from ignorance. Let this fact be tactfully brought to the pupil's notice, and he will exert greater care to avoid such mistakes. In other words, he needs to be inspired with a feeling of confidence in his own capability, and with a sense of duty to properly exercise this capability.

So I repeat, that in no other feature of the work is the wise guidance and judicious help of the teacher so necessary. But this presupposes on his part a comprehension of the fundamental principles which govern the nature of the work. The essentials underlying the teaching of composition are four in number, and are given in the order of their importance. First, foremost, and most emphatically, the attitude of teacher and pupil towards the subject; secondly, the aim to be pursued; thirdly, the material with which to pursue this aim, and lastly, methods of utilizing material.

In the attitude with which the subject is approached, lies the key to success or failure. The prevailing tone in this branch of our work has already been indicated, and I hope I may be pardoned when I say that, judging from my own experience and from observation, this picture is not unduly exaggerated. The attitude of the teacher is largely responsible for the attitude of the class. To show that the work is disagreeable, disheartening, not of primary importance, is fatal to all efforts on part of the class to exercise care and good will in their tasks. Much can be done to impress these young minds with the importance of the lesson by the spirit in which we teach it. Yet the spirit which is least seen and most needed, undivided and earnest attention, is the primary requisite to successful composition work. Undivided and earnest attention on part of the teacher, to point out and explain all important and essential points in the lesson to be prepared; concentrated attention on part of the pupil, to absorb and retain the explanations given. *If the pupil is made to realize from the very beginning that he is to be held strictly accountable for all these points*, then the battle is half won. The forced attention he gives at first, will soon become natural through habit and interest. In the early stages of the work it is advisable to allow the taking of notes, in fact, to require it; later, the memory alone should be the storehouse. It is perhaps needless to say, that the teacher must limit the number of such important points and use discretion in their selection. But he must be indefatigable in enforcing and reviewing the lessons thus taught.

Then, too, liveliness of instruction (not so difficult since we are dealing with a living language) is an important factor in securing attention. By liveliness of instruction is meant, not merely vivacity in presenting the lesson at hand, but also a common activity of both teacher and pupil, and a rapid rotation of pupils in the participation of the lesson. Perhaps in no other line of the work is it so important that the teacher should be regarded as

authoritative, therefore let the wise teacher beware of subordinating himself to the text-book or material at hand.

And lastly, another important aid in securing the desired attitude, is the frequent and careful supervision of the pupils' work, with a subsequent explanation and discussion of common errors. This supervision should take various forms, blackboard work, correcting of tasks handed in, and tests or examinations at not too distant intervals. Nothing is so effective in combatting inattention and carelessness as the watchful eye of the teacher. Prose work in a foreign language is never easy, but for that very reason it affords the greater opportunity to arouse in our pupils the pride to conquer a difficult task, to innoculate them with a taste for the sweetness of such a victory. Then will come the mental growth and vigor which will stand them in good stead when school tasks become "things of the long ago."

What the aim shall be in our instruction in composition, is a question each one of us must decide for himself, and re-decide to some extent with every new class of students. However, the aim should be uniform with the aim set for the general course; it should be, in fact, a coherent part of it. And it should be strictly limited in scope. We must confine our teaching to the regular, the ordinary, the necessary features of the language; and yet "the stream of a living language is so wide" that even the regular, the ordinary, the necessary will assume well-nigh boundless proportions, which no amount of activity can span in the limited time provided in the high school course. Therefore the imperative need of fixing a modest, attainable goal, and then steadfast and iron determination in pursuing this goal. In general, I would venture to put as the aim to be reached in the second year of high school instruction, the ability to reproduce, in simple German or French, a topic familiar from the general work done or related to it. That is to say, the pupil should be able, at the end of the second year, to *use* correctly inflected forms, proper case constructions, and the correct word-order in expressing very simply put ideas. I stress the word "use" purposely, for I mean, not only in written work should he have this ability but also in oral work. Here, however, it is well to bear in mind that in written work there is time to think and the eye to see errors, so we must not become impatient when in the oral work, correct forms come haltingly and only after several efforts. We have reason to be satisfied, if at this stage of the instruction, the learner perceives his errors and attempts to correct them. To express even the simplest ideas in a foreign tongue, requires a mastery of numerous norms.

In coming to the subject of material for composition, we find ourselves embarrassed by the superabundance which makes selection difficult. This material may be roughly classed under four headings: (1) composition books, (2) texts furnished with prose based thereon, (3) anecdotes or stories, (4) material selected and adapted by the teacher.

By prose composition books I mean such which take up, in some systematic order, grammatical principles, and furnish drill thereon in one form or

University for the first time. The errors are reproduced as they occur in the original manuscripts. For number four no preliminary oral drill was given, which, in part, accounts for the more numerous errors. The series represents the work of different pupils whose exercises are chosen at random.

I. DIE WOHNSTUBE.

Die Wohnstube war das gerämigste und hellste Zimmer in dem Haus. Sie war auch sehr schön ausgestattet, denn der Schneider hatte sowohl Schönheitssinn als Mittel. Die Möbel waren nicht alle neu, aber die altmodischen Stücke waren nicht nur solid sondern auch behaglich. An den Fenstern hingen bunte Vorhänge aber darüber waren auch weisze Vorhänge, welche die etwas grellen Farben derselben dämpften. An den Wänden waren einige gute Bilder, manche in vergoldeten, manche in reich geschnitzten Rahmen. Das schönste Bild war vielleicht das, welches über dem Sopha hing und Kaulbachs "Homer und die Griechen" darstellte. In der Ecke über dem Schreibtish war eine Marmorbüste des Zeus. An der einen Wand waren niedrige Repositorien und hier standen in langen Reihen hunderte von Büchern, einfach aber dauerhaft eingenbunden. In einem Gestell neben dem Schreibtisch waren die Wörterbücher und Bücher deren man zum Handgebrauch bedarf. Das bequeme Sopha und einige weitarmige Sessel waren mit grünem Ledertuch überzogen. Ein groszer Spiegel von Epheu beschattet hing zwischen den Fenstern. Davor stand ein Teetischchen mit zierlichen meiszener Tassen. Also konnte man hier sowohl Geist als Korper stärken.

II. EIN GESPRACH AUR DER STRASZE.

"Ei, guten Tag, lieber Freund, wie geht es Ihnen?"

"Danke, sehr gut, und wie befinden Sie sich heute."

"Ach, nicht sehr gut."

"So? Das tut mir leid. Was fehlt Ihnen?"

"Nun, ich habe mich erkältet. Meine Wohnung ist sehr unangenehm."

"Was Sie doch sagen! Ei, wohnen Sie nicht mehr in jenem groszen Palaste wo Sie letztes Jahr solche schone Wohnung hatten?"

"Nein, nicht dieses Jahr. Meine Mittel erlauben es nicht. Ich muszte eine billigere Wohnung nehmen. Die Zimmer sind etwas weniger geraumig and die Möbel sind sehr altmodlisch."

"Aber Sie wissen doch dasz altmodische Mobel oft sehr solid und bequem sind."

"Das ist wohl wahr aber meine Mobel sind Ungetume. Die Sessel sind so unbequem und das mit Ledertuch uberzogene Sopha so hart dasz man nicht darauf sitzen kann. Die Repositorien sind so hoch, dasz ich das oberste Fach nur mit Hilfe einer Leiter erklimmen kann. Es sind so viele Turen und Fenster dasz kein Wandraum ist. Also kann ich meine Bilder und Photographien nicht aufhangen. Sie kennen doch jene schönen Ansichten der Universitat welche ich im Paris kaufte? Sie bewunderten sie so oft in meiner fruheren Wohnung. Nun, die hängen in meinem dunkeln

Schlafzimmer. Und meine Sammlung von Biergläser, Tassen, und Pfeifen haben nirgends Raum."

"Armer Kerl, das ist ja alles sehr traurig. Aber trösten Sie sich. Ich komme bald auf Besuch zu Ihnen und bringe einige Universitätsfreunde mit. Dann halten wir ein kleines Gelage und singen die alten lustigen Studentlieder und Sie werden alle Ihre Sorgen vergessen. Aber jetzt muss ich beeilen, ich habe nämlich eine Klasse. Adieu für heute."

"Auf Wiedersehn!"

III. MEIN ZIMMER.

Mein Zimmer liegt mitten im ersten Stockwerk. Es ist ungefähr fünfzehn Fuss lang bei fünfzehn Fuss breit. Es macht einen behaglichen Eindruck wenn man hineintritt. Es hat ein groszes Fenster welches gegen Osten liegt und an dem weisze Vorhänge hängen. Zwei Türen öffnen auf auf andere Zimmer und eine auf den Flur. Die Wand hat grüne geblümte Tapeten. An der Wand hängen Bilder, Landschaften und Porträte Mein Lieblingsbild ist das, welches einen See im Mondschein darstellt. Das Zimmer ist mit Dampf geheitzt. Da sind zwei Schaükelstühle und zwei andere Stühle in dem Zimmer. Ein mit Ledertuch überzogenes Sopfa steht in einer Ecke, und in der anderen, ein Tisch auf welchem Bücher und Tinte und eine Studierlampe sind. Dem Tisch gegenüber sind Repositorien, in welchen Geschichtsbücher und Schulbücher sich befinden. Darüber ist eine mit grünem Tuch beschattete Konsole. Darauf stehen Tassen und eine Uhr. Auf dem Boden liegt ein dunkler Teppich.

IV. WIE ICH EIN ZIMMER FAND.

Ich war eben in Ann Arbor angekommen um die Universität zu versuchen. Ich trat auf die Statestrasze um eine Wohnung zu finden. Da ich die Stadt wenig kannte, war ich etwas in Verlegenheit, als ich eine bekannte Gestalt sah. Sie war meine gute Freundin Margarete, die in meiner Vaterstadt wohnt.

"Liebe Freundin," rief sie, "woher bist du gekommen, und wie geht es dir?"

"Das ist eine angenehme Überraschung," sagte ich. "Es freut mich dich zu sehen. Ich weisz nicht was zu tun. Ich wollte eine Wohnung finden. Was ist der beste Teil der Stadt für eine Studentin?"

"Oho," sagte sie, "Bist du hier gekommen die Universität zu versuchen?"

"Richtig," lachte ich, "Und du muszt mir helfen."

"Ich kenne gerade das Haus. Es ist das Haus wo ich wohne. Es sind zwe unbenutze Räume gegenüber meinen Zimmern, und sie werden dir gewisz gefallen."

"Recht gut," antwortete ich, "Also gehen wir."

Wir traten ungefähr fünf Minuten, als wir zu dem Haus kamen, wo Margarete wohnte. Wir stiegen die Treppe hinauf, und gingen in das Haus. Wir waren bei einer freundlichen Dame getroffen.

University for the first time. The errors are reproduced as they occur in the original manuscripts. For number four no preliminary oral drill was given, which, in part, accounts for the more numerous errors. The series represents the work of different pupils whose exercises are chosen at random.

I. DIE WOHNSTUBE.

Die Wohnstube war das gerämigste und hellste Zimmer in dem Ha Sie war auch sehr schön ausgestattet, denn der Schneider hatte sow Schönheitssinn als Mittel. Die Möbel waren nicht alle neu, aber die modischen Stücke waren nicht nur solid sondern auch behaglich. An Fenstern hingen bunte Vorhänge aber darüber waren auch weisze Vorh welche die etwas grellen Farben derselben dämpften. An den W waren einige gute Bilder, manche in vergoldeten, manche in reich ges ten Rahmen. Das schönste Bild war vielleicht das, welches üb Sopha hing und Kaulbachs "Homer und die Griechen" darstellte. Ecke über dem Schreibtish war eine Marmorbüste des Zeus. An Wand waren niedrige Repositorien und hier standen in langen Rei derte von Büchern, einfach aber dauerhaft eingenbunden. In eine neben dem Schreibtisch waren die Wörterbücher und Bücher zum Handgebrauch bedarf. Das bequeme Sopha und einige Sessel waren mit grünem Ledertuch überzogen. Ein groszer Epheu beschattet hing zwischen den Fenstern. Davor stand e chen mit zierlichen meiszener Tassen. Also konnte man hier als Körper stärken.

II. EIN GESPRACH AUR DER STRASZE.

"Ei, guten Tag, lieber Freund, wie geht es Ihnen?"

"Danke, sehr gut, und wie befinden Sie sich heute."

"Ach, nicht sehr gut."

"So? Das tut mir leid. Was fehlt Ihnen?"

"Nun, ich habe mich erkältet. Meine Wohnung ist se

"Was Sie doch sagen! Ei, wohnen Sie nicht mehr Palaste wo Sie letztes Jahr solche schöne Wohnung hatten

"Nein, nicht dieses Jahr. Meine Mittel erlauben es eine billigere Wohnung nehmen. Die Zimmer sind etwas and die Möbel sind sehr altmodisch."

"Aber Sie wissen doch dasz altmodische Möbel bequem sind."

"Das ist wohl wahr aber meine Möbel sind Ungeti so unbequem und das mit Ledertuch überzogene Sop nicht darauf sitzen kann. Die Repositorien sind s oberste Fach nur mit Hilfe einer Leiter erklimmen k Türen und Fenster dasz kein Wandraum ist. Also und Photographien nicht aufhängen. Sie kenn sichten der Universität welche ich im Par so oft in meiner früheren Wohnung.

"Frau Neumann," sagte meine Freundin. "Ich habe meine Lieblingsfreundin gebracht, die unbenutzten Räume anzusehen."

"O, wenn sie wünscht," antwortete die Frau. "Dann kommen Sie, die Räume sind im zweiten Stockwerk."

Die Zimmer waren sehr schön und behaglich und bestanden aus ein Studierzimmer und eine Schlafstube.

"Die Räume sind sehr gut hergestellt," meinte Frau Neumann.

"Ja," antwortete ich, "und ich sehe dasz es gute Repositorien sind. Das freut mich."

"Auch sind die Möbel sehr zierlich und behaglich, und sieh! solche schönen Bilder an den Wänden," rief meine Freundin. "Ja," sagte ich, "sie gefällt mir, und wenn der Preis nicht zu—

"Nur drei Taler die Woche," fiel die Dame ein.

"Dann," sagte ich, "ich werde die Wohnung nehmen."

These exercises, with the exception of number four, were first prepared in class orally, then written, usually in part only, under the teacher's supervision, thus giving opportunity for questions concerning words, expressions, grammatical facts. For the home task such an exercise was copied in a revised, corrected, and completed form. These papers were next examined, marked, and returned to the pupils for correction and discussion of errors, for which a part of a recitation hour is devoted. Number four was meant to serve as a test, hence no class preparation, aside from a few necessary suggestions, was given for this exercise. This explanation leads me to the last topic, that of method.

There is no single method, nor "best" method for teaching composition, nor is it at all important that one should be discovered or invented. For nowhere else in our instruction is the danger of dull routine work so great, nowhere else the necessity for new lesson-plans, for fresh spirit so abiding, just because we meet here our greatest difficulties. So we need for it all our best enthusiasm and interest, and whatever our methods, these need to be continually revised and imbued with new life. Experience and observation have been impressing on my mind two points as to method. In the first place, we leave our pupils too much to the intricacies of grammar and dictionary, to their ignorance of how to attack the lesson at hand, and their consequent dislike of composition work. Definite lesson-plans, preliminary oral drill, preparation, at least in part, under supervision, will result in clearer ideas, a firmer grasp on the material to be prepared; will result in a better understanding of grammatical features, and consequently, in more correct and encouraging work. Furthermore, I am inclined to believe that we have too much written work, or to express myself more exactly, we confine our teaching of composition too exclusively to written work. I fully appreciate the valuable lessons taught by well written and carefully prepared tasks, the habits of industry and neatness thus acquired. Pupils often prefer the written work to the oral and why? Because, not infrequently, it means a substitute for mental effort instead of an aid to it.

If the written composition is to be profitable, it must recall and put into visible form that which is already familiar and understood; it should be regarded as a means to fix this knowledge still more permanently in the learner's mind, to reveal any haziness or error existing there. In short, the written exercise should give definiteness and fixity to lessons already learned. But it is the oral work particularly which leads the pupil nearer to the language itself. I think it is Sweet who says, "The living spoken form of every language should be made the foundation of its study." And so, why not put the study of the language in a living, spoken form?

THE QUESTION AND ANSWER METHOD IN MODERN LANGUAGE TEACHING.

JOHN E. LAUTNER, PROFESSOR OF MODERN LANGUAGES IN THE NORTHERN STATE NORMAL, MARQUETTE, MICH.

Modern language instruction has undergone a revolution in the last two or three decades. It is not the province of this paper to give a history of this revolution. Suffice it to say here that the radical leaders of this revolution have rejected as worthless, or even injurious, the use of a grammar or text-book, translations from the mother tongue into the foreign and vice versa, and have tried to banish completely the use of the mother tongue from the classroom. Various names have been given to this method, as, among others, the "natural method," "conversational method," "the new method," "the direct method," etc. Meanwhile many of the conservatives and reactionaries have clung with persistent tenacity to the so-called "old method," "grammatical method," etc. It is our opinion that the extremists, as is always the case in radical changes, are gradually finding a medium ground. An adjustment of the two extremes is gradually taking place. Most of us are agreed, I hope, that the use of the foreign language in the classroom is no longer looked upon as heresy but as an absolute necessity. The same thing is true precisely of grammar. The question no longer is "either or or" but How can we use *both* most effectively? This is *the* question before us. My own experience leads me to the firm conviction that a wise combination of the two methods produces the best results. The more thoroughly the fundamental principles of grammar are taught the better, and the more the actual living language can be used by the instructor and the class the better. But *how?* That is, as I have already said, the most difficult problem before us.

I wish to discuss for a moment a method by which the foreign tongue can be used in the classroom. I mean the Question and Answer method, or the Socratic method, as it is often called in Pedagogy. Now this is no new method, as you are all aware; in fact it is as old as instruction

itself. But this antiquity of the method does not argue against its efficiency. On the contrary, it is an argument in its favor. Then, too, it is not simply old but it is still used in all departments of instruction as one of the most effective methods. What *does* this method and what *can* it accomplish in modern language? To answer this question it is necessary to have some standard by which to measure its value. This standard is contained in the answer to the question, What does it mean to *know* a language?

An analysis of this question will reveal only commonplace truths, but they are essential to a correct understanding of the problem.

Language for our present purpose is in the main a system of more or less arbitrary symbols used for conveying ideas from one mind to another. These symbols are now of two kinds, viz., visual and auditory. A complete knowledge of a language would mean a complete knowledge of these symbols, *i. e.*, ability to interpret and use them together with a knowledge of their phonetic and *semaceological* changes which they have undergone in their historical development. In other words, we must be able to read, to understand, to write, to speak the language. We have therefore in the learning of a language four different processes, viz., Seeing, Hearing, Speaking and Writing, two of which are sensory and two motor processes. That is, we have two channels of "impression" and two of "expression."

We wish especially to emphasize the fact that these four processes are separate and distinct processes, *i. e.*, we may have mastered one of them and know nothing of the others. This statement is supported by the very common emperical observation that one can read and not speak a language, or one may be able to understand the speech of another and yet not be able to speak the language himself. Then, too, Physiological Psychology has emphasized the independence of these sensory processes by the localization of brain functions. As is well known now the visual centre and auditory centre are not located in the same part of the brain, so with the motor centres of speech and writing. Before we are able to understand and use with equal facility the written and the spoken word, associational tracks have to be formed between the centres of sight, hearing, voice and hand movements, connecting these various sensory and motor centres.

Since these four processes are separate and consequently require different exercises to develop them, the question naturally arises which should be developed first; or should they all be and can they all be developed simultaneously? Is one process of greater importance than the others and hence should receive the emphasis or even exclusive attention? This is one of our great problems in modern language work. Before the invention of printing the auditory symbols were unquestionably of greater importance than the visual symbols, for the human voice was then the chief means of conveying ideas from one mind to another. In modern times, however, the specific social environment in which the individual lives must determine which of these is most important. For example, it is obvious that a resident of the United States will very likely not attach the same degree of import-

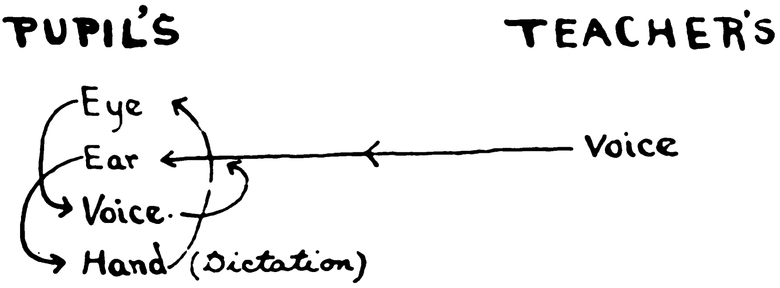
ance to the ability to speak the German language as a resident of Holland or Switzerland.

There is right here a very fertile field for the physiological psychologist. He ought to be able to prove the relative tenacity of visual, auditory and motor symbols or tracks, and hence give us a scientific foundation upon which to base our instruction. He ought to be able to show us to what extent each one of these symbols supports or maintains the others if vitally connected by the laws of association.

For the present, therefore, our conclusions must rest on imperial observation, and this leads us to the conclusion that the more we exercise the eye, ear, voice, and hand the more lasting the impression of a word will be. Each word has, so to speak, four roots, two sensory roots grounded in the visual and the auditory centers, and two motor roots grounded in the exercise of voice and hand. A word, therefore, with these four roots thoroughly developed will have a firmer hold in the memory-ground, if I may use this term, than one which has only one root.

Secondly, our observation also teaches us that, inasmuch as it is often uncertain as to which of the four processes a student may have most use for, the wisest thing to do is to give him a general training in all. A general elementary knowledge of reading, speaking and writing a language is as wise and as essential as a general education before a special training for a definite vocation. It would, indeed, be very helpful to our elementary instruction if some clever and careful investigator could give us, say, the 1,000 words in most common use. If this could be ascertained there would be little room for doubt as to what should constitute the material for our elementary instruction.

If, therefore, we are right in claiming that to know a language means ability to interpret and to use the auditory and the visual symbols, including in all four relatively distinct processes, viz., seeing, hearing, speaking and writing, then the pedagogical value of the Question and Answer as a method of Modern Language instruction is readily obvious. The question and answer, if rightly handled, will develop all four of these processes. For example:



It is plain from this diagram that a question which demands an immediate answer exercises only two of the language organs, viz., the ear and the voice, but dictation and recitation exercises them all.

The question and answer method, in our opinion, gives us at least a partial solution of the vexed and much discussed question, Can and ought the foreign language to be used in the class room? Of course it can and ought to be used. There are many other ways in which it can be used, but we are satisfied that the method under discussion is sound and can with profit be used by any teacher who is prepared to use it. There has been a lot of precious time and energy wasted by lecturing in the foreign tongue *over* the pupil, *under* the pupil and all *around* the pupil, but not *into* the pupil. The method we here advocate has the merit of giving the pupil *something*, and it can be used by a greater number of teachers, as they are at present prepared, than any other. I think we often expect too much of a few years of modern language work. We surely cannot hope to learn the whole language in that time, and yet if we propose to teach conversation people wonder why we can't turn out perfect linguists in a short time. The learning of only *one* language, that of our mother tongue, is a life work and can never be complete. How, then, is it possible to obtain in a few years a perfect command of several foreign tongues? But we can give the pupil a fair start in this direction. We can give him such a start in the elements of the language that he will find it comparatively easy to take up or continue a more specialized knowledge of the language if his vocation in life should demand it. This general training of all the fundamental language processes should, it seems to us, be steadily before the eye of the teacher who is dealing with students who are still getting a general education.

The text-books to be selected for this work should contain only the vocabulary in most general use, and should, in addition to grammatical principles and forms, contain easy texts in the language taught, together with and without questions. It will tend materially to enhance the interest of the class if the teacher formulates and dictates her own questions and requires her pupils to form questions which are answered and corrected in class. We have found it very useful, *e. g.*, to select for questions and answers, say, one page of the text used, ask the pupils to construct questions on this and have them become so familiar with this portion of the text that they can answer any questions based upon it. There is, of course, plenty of room here for the ingenuity of the teacher, but a few simple questions dictated by the teachers or formulated by the pupil each day on the text used will show very satisfactory results. These should be confined to the easier portion of the text which does not need to be translated; the more difficult portions should always be translated.

It is right here in connection with difficult passages that we are not yet clear as to how far the foreign language can and ought to be used. Our experience thus far leads us to the conclusion that in the interpretation of difficult passages which are often difficult of comprehension when couched in plain English, we are wasting valuable time in trying to give the explanation in the foreign tongue. I hope we shall hear from teachers who have tried to use exclusively the foreign tongue in teaching the classics.

The discussion of any method of instruction necessarily involves the consideration of the teacher's preparation, *for the teacher's preparation determines his method.* It is worse than useless to attempt to use a method for which the teacher is not prepared. And that is largely the case with the method that we are advocating in this paper. The teacher, to use this method with the greatest degree of success, should really handle the foreign tongue as readily as the foreigner himself. This would be ideal. But very much may be accomplished with a lesser degree of facility in the spoken language. Even the slightest acquaintance with the spoken language can be used to advantage. On the other hand the teacher who has been trained only in grammar, translation, written composition and old dialects will fail in the use of this method. A teacher thus trained is only half prepared, and, worse than that, she is wrongly prepared, because had she spent some of her time in trying to get the living language instead of the dead language she would be infinitely more efficient. Now I am going to make a heretical statement, although I am glad to say that in some institutions it is no longer regarded as heresy, viz., that if the teacher in getting her preparation in German had to choose between a knowledge of all the old dialects, Gothic, O. H. G., M. H. G., and Old Norse and even Indo-European, and one year's residence in Germany, she would be infinitely wiser to choose the latter. The ideally prepared teacher should have mastered at least one old dialect and have a general knowledge of the history of the language. Often hints can be drawn from this source which are very practical and develop interest. For example, the words der Buchstube, die Buche, das Buch can be impressed upon the memories of the pupils much more effectively if the teacher can tell them why they are so much alike in form and yet so different in meaning. In fact the teacher can unroll a veritable "Kulturbild" from these few words. This is true of many other words which the elementary students will understand without much knowledge of phonetic changes, and the teacher does not need much of this knowledge to give the necessary explanation.

The point we wish to emphasize is that the student who has to learn the foreign tongue should first be thoroughly grounded in the modern language before he takes up dialects the form of which resemble the modren forms so closely that he simply gets both confused.

The institutions which prepare the modern language teacher for her work are and always will be chiefly responsible for the way these languages are taught. In our opinion many of these institutions will have to modify their courses of study before they can hope to give the most practical a most efficient preparation to the teacher.

There has often been and still is too much emphasis on the old dialects before the student has sufficiently mastered the living language. For much of the written translations into the German, based on such a work as Harris' composition, more conversation and spontaneous exercises should be substituted. A certain amount of such translation work is essential to

the better understanding of the structure of the German sentence as compared with that of the English, but on the whole this kind of work has been much overestimated in giving the student a ready mastery of the language. Much valuable time of both pupil and teacher have actually been wasted.

The universities in addition to giving more oral and spontaneous composition should provide for courses of lectures given entirely in the foreign tongue. The German universities have long had their "Lector." Some such system ought to exist in every institution that claims to prepare students to teach modern languages. Residence abroad should be emphasized by lectures given on this subject informing students of the absolute necessity of such a course if they wish to be rightly prepared and advising them as to ways and means. The excellent opportunities offered by the best continental summer schools for those who cannot afford to be away a whole year, should receive special emphasis. Yes, it would not be too fanciful for the universities to suggest to its students that the time may come when residence abroad will be made a requirement, say for granting a life certificate in modern language.

To assist needy and worthy students travelling fellowships in modern language should be established. We need these fellowships infinitely more than the student of the classics. If it is deemed essential that the classical philologist should see a few original inscriptions carved on dead stone how much more important is it that the student of modern languages should feel the pulse of the warm, living blood as it bounds through the veins of a mighty people still a prominent factor in moulding the destiny of the world.

If the universities will emphasize these things the student will feel that he is not studying a dead language but a living language—a language representing a people that are, to say the least, still very much alive. I do not think that it is possible for any one who has not actually lived among the Germans for a considerable period of time to realize the tremendous energy of this nation. The classical period of German literature, using literature in its broadest sense, is perhaps the richest the world has ever seen, and yet this is but a part of Germany. The industrial position that Germany is gradually assuming among the nations of the world is perhaps of equal importance to the teacher of German. It is of this modern living Germany, with its hopes and ambitions, that we as teachers are often densely ignorant.

Wilhelm von Polenz, in his recent work on America, entitled "Das Land der Zukunft," says: "Es gibt nicht zwei Völker auf dem ganzen Erdenrund, die so viel von einander lernen Könnten, wie das Amerikanische und das deutsche, und es gibt keine zwei Völker, die vorlaufig sich so wenig im innersten Kern ihres Wesens verstehen, wie grade diese beiden."

This view is shared by other scholars who have really studied this question.

A most interesting report has recently been published on this subject by the "Department of Commerce and Labor" at Washington, D. C. It is entitled, "Industrial Education and Industrial Conditions in Germany."

This work should be read by every teacher of German. It can be secured free by sending to the department for it. This study shows how Germany is very liable to surpass us in our own boasted field, viz., industry. They have industrial schools to prepare for every specialized industrial trade. But we cannot go into details. We cannot, however, refrain from citing a few sentences (p. 149): "As we extend our export trade the men we meet and the wares with which we have to compete are German. While England is feeling the force of the German Empire's facilities in securing trade at present, we are not to be exempted. No competitor with whom we will have to deal is so well prepared for success in the world's markets as is Germany."

In the "Daily Consular Report" of Jan. 27, 1905, issued by the same department, we find a report of the impression of America as carried back to Germany by a German commission appointed to visit the St. Louis Exposition and incidentally to study industrial conditions in different parts of our own country. Among other things Mr. Mason, U. S. Consul-General at Berlin, who sums up these impressions of our country as given out in Germany, says: "There has been noticed, to begin with, on the part of our people, a general feeling of complacent satisfaction with everything American, a secure conviction that whatever is done or produced by them is the best, and that they have only to keep on as they have begun to have the future securely in their hands. There is, say these critics, a pervading ignorance and indifference about everything outside of the United States that, from the German standpoint, will be, unless corrected, a serious handicap in our quest for foreign trade. The careless confidence with which agents and salesmen are sent abroad, with no special preparation and with no knowledge of any language but their own to do business in countries where only a trifling percentage of the population understand English, strikes these careful, methodical European experts as amazing." * * * Reduced to its simplest terms, these investigators generally conclude that the reliance on a general and more or less superficial education, together with natural adaptability, to fit young men for almost every walk in life, and the lack of specialized study in physical science, modern languages, and the industrial arts, will, if persisted in, neutralize much of the advantage which our country enjoys through natural resources and advantageous geographical position for the South American, Mexican, and Asiatic trade. They note, also, the enormous disparity between American and European wages, the high rates charged by express companies, and the general heavy cost of handling business in the United States, and conclude that on the whole the "American danger" has been greatly exaggerated, and that a steadfast adherence by Germany to the educational system and commercial methods now in practice will leave the Fatherland little to fear in future competition with American manufactured goods."

Now some one may say what has all this got to do with my subject for discussion. It has everything to do with it. The question and answer method breathes and fosters the living spirit of the language and leads

naturally to the living Germany. We should never lose sight of the supreme function of the modern language teacher which is to stand as mediator between our civilization and the civilization of the foreign nation his language represents. This function of the teacher receives additional emphasis in recent theories of social progress. Such men as Tarde in France, Balwin in America, and the representatives of the "Völkerpsychologie" in Germany have shown that progress in civilization depends largely on the conditions which make possible "intercerebral" activity, *i. e.*, interchange of ideas between individuals. Isolated man makes little or no progress. Civilization is chiefly the product of the interaction of social forces, and it is the foreign forces that the modern language teacher should try to connect with our own and thus make possible the highest development of our own people.

Synopsis of Business Meeting

UNIVERSITY HALL, April 1, 1905.

The meeting was called to order by President J. L. Snyder. The minutes were read by the Secretary, L. P. Jocelyn. Reports were made by the Secretary, Treasurer J. P. Everett, and Chairman of the Auditing Committee, J. L. Markley. The reports were adopted.

SYNOPSIS OF TREASURER'S REPORT.

Balance last reported	$ 30 69
Receipts	508 00
Total	$538 69
Disbursements	415 53
March 22, 1905—Balance on hand	$123 16

The chief items of expense are (1) printing the proceedings, (2) printing 3,000 programs and mailing them, and (3) the expense of the speakers at the general meetings.

The nominating committee consisted of H. M. Slauson, N. T. Bishop, N. G. Cobern, S. O. Hartwell and L. P. Jocelyn. They made the following report, which was adopted:

For President—Professor A. S. Whitney, University.
For Vice-President—Miss Edith E. Atkins, Lansing.
For Treasurer—Principal J. P. Everett, Adrian.
(The Secretaryship is permanent.)
For the Executive Committee, the above officers and
President L. H. Jones, Normal College.
Principal T. P. Hickey, Battle Creek.
Upon motion of B. A. Finney, the chair appointed
Mr. B. A. Finney, University Library,
Superintendent R. S. Garwood, Marshall,
Miss Mildred Smith, Ypsilanti,

as a committee to investigate the condition and resources of the high school libraries of the State, and report at the next meeting of the Club.

The Secretary called attention to the great growth of the Club and the need of a new Constitution and a new set of By-Laws, to assist the officers to properly manage all phases of the Club, and suggested that a committee be appointed for such purpose.

Upon motion of C. F. Adams, Detroit, the chair appointed as such committee:

J. O. Reed, University.
E. L. Lyman, Normal College.
David Mackenzie, Detroit.
J. L. Drake, University.
L. P. Jocelyn, Ann Arbor.

Upon motion of the Secretary, the Executive Committee were given power to change the days of meeting to Wednesday, Thursday and Friday.

Superintendent S. O. Hartwell gave the report of the Committee on High School Athletics, and it was adopted. (The report is printed in full on pages 10–13.)

Principal A. J. Volland, Grand Rapids, was elected to succeed himself for a period of five years as member of the State Athletic Committee.

Superintendent L. L. Wright, Ironwood, was elected to fill the unexpired term of L. H. Baker as member of the State Athletic Committee.

Program of the General Sessions and Conferences

FRIDAY.

1. The Nature of Culture Studies,
   Professor R. M. Wenley, University of Michigan.
2. The School of the Future,
   Professor Liberty H. Bailey, Cornell University.
3. Music,
   University School of Music Quartet.
4. Work in a Psychological Laboratory,
   Professor James R. Angell, University of Chicago.

Musical Recital,
   Faculty of the University School of Music.

Address—The University and the Nation,
   President Woodrow Wilson, Princeton University.

SATURDAY.

1. The School and the Library,
   Mr. W. H. Brett, Librarian Cleveland Public Library.
   Discussion:
   1. Mr. H. O. Severance, University of Michigan Library.
   2. Superintendent H. M. Slauson, Ann Arbor.
2. The Greek in English,
   Mr. Edwin L. Miller, Englewood High School, Chicago.
3. Music,
   University School of Music Quartet.
4. Business Meeting.
5. Athletics in Michigan Secondary Schools,
   Superintendent S. O. Hartwell, Kalamazoo

CLASSICAL CONFERENCE.

THURSDAY.

1. In the Footsteps of Caesar in Gaul: Gergovia,*
   Principal George R. Swain, Bay City High School.
2. Ten Classical Conferences: A Retrospect,
   Professor Francis W. Kelsey, University of Michigan.
3. Do Latin and Greek need something done for them in the schools?
   Principal J. Remsen Bishop, Eastern High School, Detroit.
4. Roman Brickstamps: Their Form, Significance and Value,
   Principal Irving B. Hunter, West Bay City High School.
5. Some Roman Brickstamps from the Collection of the University of Michigan,
   Mr. Henry M. Gelston, Bay City High School.
6. Some Poetic Uses of Geographical Expressions in Latin,
   Professor C. F. Ross, Allegheny College.
7. Pompeian Wall Scribblings,
   Miss Louise M. Breitenbach, Liggett School, Detroit.
8. The Municipal Senate in the African Provinces,
   Dr. T. L. Comparette, Hicksville, Ohio.
9. Attitude of Hadrian toward Inscriptions upon Buildings restored by him,
   Dr. Duane Reed Stuart, University of Michigan.
10. The Value of a Year in Italy for the Training of a Latin Teacher,
    Miss Fannie E. Sabin, State Normal School, De Kalb, Illinois.
11. The Social Structure of Gaul in the Time of Caesar,
    Principal Ira A. Beddow, Olivet College.
12. Effect of Physiographic Features upon the Movement of Population,*
    Professor C. H. VanTyne, University of Michigan.
13. The Title "Praetoria" in the Roman Navy,
    Mr. Orlando O. Norris, State Normal College, Ypsilanti.
14. Some Points in the Literary Study of Virgil,
    Professor Charles Knapp, Columbia University.

Address—The Lost Parts of Latin Literature,
  Professor Andrew F. West, Princeton University.

FRIDAY.

15. The Latest Excavations in the Roman Forum,
    Professor Walter Dennison, University of Michigan.
16. Palaeographical Miscellany,
    Professor John M. Burnam, University of Cincinnati.
17. The Eleusinian Mysteries,*
    Professor Arthur Fairbanks, University of Iowa.
18. The Ara Pacis of Augustus, and Its Restoration,*
    Professor James C. Egbert, Columbia University.

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*Illustrated with the stereopticon.

JOINT SESSION OF THE CLASSICAL AND MODERN LANGUAGE CONFERENCES.

THURSDAY.

The Remains of Ancient Greek Music, and an experiment with Latin metres.
Professor W. H. Wait, University of Michigan, and Miss Leila Farlin, University School of Music.

Address—Prevailing Methods in the Study of Mood-Syntax in the Indo-European Languages: Their History and Their Aim.
Professor William Gardner Hale, University of Chicago.

CONFERENCE OF PHYSICS AND CHEMISTRY.

THURSDAY.

1. Report of Committee—A Proposed List of Experiments for Beginning Chemistry.
2. What Should be Taught in Beginning Chemistry?
   Professor F. S. Kedzie, Michigan Agricultural College.
3. The Chemistry Note Book.
   Mr. E. J. Wilson, Adrian.
4. Quantitative Determination of the Strength of an Acid by Means of a Weighed Amount of Sodium.
   Mr. M. A. Cobb, Lansing.
5. Analysis of Nitric Acid.
   Mr. B. W. Peet, Michigan State Normal College.
6. The Determination of the Per Cent of Carbon Dioxide in Calcium Carbonate.
   Mr. J. W. Matthews, Western High School, Detroit.
7. Quantitative Relation between Acids, Bases and Salts: the Preparation of Primary and Secondary Salts of Sulphuric Acid.
   Mr. R. R. Putnam, Eastern High School, Detroit.
8. The Volumetric Synthesis of Water.
   Professor G. A. Hulett, University of Michigan.
9. A Simple Experiment to Determine the Volumetric Composition of Ammonia.
   Mr. L. S. Parmelee, Flint.

FRIDAY.

1. A Contact Key for the Slide-Wire Bridge.
   Mr. H. L. Curtis, Michigan Agricultural College.
2. A Simple Resonator.
   Mr. M. A. Cobb, Lansing.
3. A Simple Means of Illustrating the Principle of Step-up and Step-down Devices.
   Mr. De Forrest Ross, Ypsilanti.

4. An Account of Experiments to Ascertain Whether the Human Organism Obeys the Principle of the Conservation of Energy,
   Dr. Arthur W. Smith, University of Michigan.
5. A Wireless Telegraph Outfit,
   Superintendent J. J. Marshall, Romeo.
6. Melde's Apparatus for Boyle's Law,
   Mr. C. S. Cooke, Central High School, Detroit.
7. Coefficient of Expansion of Air Under Constant Pressure,
   Mr. E. A. Clemans, Central High School, Detroit.

SATURDAY.

1. Report of the Committee on Mathematics and Physics,
   Mr. Charles W. Burrows, Central High School, Detroit.
2. Some New Apparatus for Experiments in Vibratory Motion,
   Professor John O. Reed, University of Michigan.
3. The Algebraic Equations of Lissajous' Curves,
   Professor G. E. Marsh, Case School of Applied Science, Cleveland, Ohio.
4. Density Measurement by the Manometer; Pressure Measurement by the Manometer,
   Professor F. L. Keeler, Central State Normal School.
5. A Device for Releasing the Ball upon the Inclined Plane,
   Mr. V. R. Hungerford, Decatur.
6. An Apparatus for Illustrating the Equality of Expansion of Different Cases.
   Mr. C. F. Adams, Central High School, Detroit.
7. An Electric Pendulum for Laboratory Use,
   Mr. W. H. Hawkes, Ann Arbor.

JOINT MEETING BIOLOGICAL CONFERENCE AND SCIENCE TEACHING.

FRIDAY.

A FIELD STUDY SYMPOSIUM.

1. Elementary Field Work: Aims and Methods,
   I. B. Meyers, School of Education, University of Chicago.
   Discussion opened by Professor L. H. Bailey, Cornell University.
2. Aims and Methods of Physiographic Field Work in Secondary Schools,
   Professor M. S. W. Jefferson, State Normal College.
   Discussion opened by Professor R. D. Calkins, Central Normal School.
3. Aims and Methods of Zoölogical Field Work in Secondary Schools,
   Curator C. E. Adams, University of Michigan.
   Discussion opened by Miss Jessie Phelps, State Normal College.

4. Aims and Methods of Botanical Field Work in Secondary Schools. Illustrated with lantern.
   Dr. H. C. Cowles, University of Chicago.
   Discussion opened by E. N. Moseley, Sandusky High School.
5. Field Work in Botany for the Winter Season,
   J. Harlan Bretz, Albion College.

MATHEMATICAL CONFERENCE.

FRIDAY.

1. The Use of Graphs and Graphic Methods,
   Miss Sadie M. Alley, Western High School, Detroit.
2. Non-Euclidean Geometry,
   Dr. Louis C. Karpinski, University of Michigan.
3. Certain Aspects of the Present Teaching of Secondary Mathematics,
   Mr. Claude I. Palmer, Armour Institute, Chicago, Ill.

ENGLISH CONFERENCE.

FRIDAY.

No formal papers were presented, but teachers of English Composition and Literature were invited to come together for presentation of difficulties and for free conference on methods and aims in coördinating and conducting the various branches of the work.

HISTORY CONFERENCE.

FRIDAY.

1. The Motive of the French Alliance in the American Revolution.
   Professor C. H. VanTyne, University of Michigan.
2. Principal Weaknesses Shown by Students in the Introductory Work in History at the University, with some Consideration of a Remedy.
   Professor Earle W. Dow, University of Michigan.
3. Use of Stereopticon in the Teaching of History, Illustrated with the Lantern.
   Professor C. H. VanTyne, University of Michigan.

MODERN LANGUAGE CONFERENCE.

THURSDAY.

1. Through the William Tell Country,
   Miss Anna M. Barnard, Central State Normal School.
2. Recent French Poetry,
   Professor Arthur G. Canfield, University of Michigan.

3. Composition of the Nibelungenlied,
   Dr. Ida Fleischer, Michigan State Normal College.
4. The Dramas of Gustav Freytag,
   Professor J. A. C. Hildner, University of Michigan.

GERMAN CONFERENCE.

FRIDAY.

1. The Essentials of German Composition,
   Miss Alice E. Rothmann, Ann Arbor High School.
2. Should the Study of the German Classics be taken up in our High Schools?
   Professor Johannes Zedler, Albion College.
3. Some Methods of Arousing Interest in the Class Room,
   Miss Alice Maud Pound, Western High School, Detroit.
4. The Question and Answer in Modern Language Instruction. Its Import and Pedagogical Value.
   Professor John E. Lautner, Northern State Normal School.

PAID UP MEMBERS OF THE MICHIGAN SCHOOLMASTERS' CLUB FOR THE LAST THREE OR MORE CONSECUTIVE YEARS

Austin, E. Jane.......Detroit Central
Arbury, F. W.......Detroit
Adams, C. F.......Detroit Central
Angell, J. B.......University
Arbaugh, W. B.......Ypsilanti

Beman, W. W.......University
Bishop, Harriette.......Detroit Central
Brown, Hugh ....Chicago
Bronson, C. M.......Toledo
Buell, Bertha G.......Ypsilanti

Cooke, C. S.......Detroit Central
Crittenden, A. R.......Olivet College
Curtis, A. E.......Adrian
Chute, H. N.......Ann Arbor
Coburn, W. G.......Battle Creek
Cody, A. N.......Flint
Curtis, G. H.......Gaylord

D'Ooge, Benj. L.......Normal College
Davis, J. B.......Detroit Central

Everett, J. B.......Adrian
Finney, B. A.......University Library

Green, Loa ....Big Rapids
Gallup, E. A.......Ann Arbor
Garwood, R. S.......Marshall
Goddard, Mary A.......Normal College

Halsey, L. R.......Chicago, Ill.
Haug, Bernice L.......Detroit Central
Hawkes, W. H.......Ann Arbor
Hull, Isabella H.......Detroit Central

Isbell, W. N.......Plymouth
Irwin, F. C.......Detroit Central

Jocelyn, L. P.......Ann Arbor
Jones, L. H.......Normal College
Jamieson, Clara O.......Ann Arbor

Kelsey, F. W. .... University
Keller, F. W. .... Central Normal

Ludwig, W. A. .... Union City
Lyons, D. F. .... Fenton
Laird, S. B. .... Normal College
Lewis, W. F. .... Port Huron
Lyman, E. A. .... Normal College

Mays, V. G. .... Ann Arbor
Montgomery, Jabez .... Ann Arbor
Markley, J. L. .... University
Miner, Mary L. .... Detroit Eastern
McElroy, E. M. .... Three Rivers

Norton, L. S. .... Jackson
Nutt, H. D. .... Chicago, Ill.

Peet, B. W. .... Normal College
Porter, Alice .... Ann Arbor
Putnam, Daniel .... Normal College
Paine, Lillian W. .... Detroit Central
Palmer, E. D. .... W. Bay City
Pettee, Edith E. .... Detroit Eastern
Phelps, Jessie .... Normal College

Rebec, George .... University
Righter, L. E. .... Sault Ste. Marie

Swain, Geo. R. .... Bay City
Springer, D. W. .... Ann Arbor
Slauson, H. M. .... Ann Arbor
Snyder, J. L. .... Mich. Agr. College
Stone, J. C. .... Normal College
Strong, E. A. .... Normal College

Volland, A. J. .... Grand Rapids

Wines, L. D. .... Ann Arbor
Werriner, E. C. .... Saginaw, E. S.
Whedon, Sara .... Ann Arbor
Watkins, E. D. .... Ithica

PAID UP MEMBERS OF THE MICHIGAN SCHOOLMASTERS' CLUB FOR 1905

Atkins, Edith Emma.................Lansing
Austin, E. Jane.................Detroit Central
Arbury, F. W.................Detroit
Adams, C. F.................Detroit Central
Angell, J. B.................University
Arbaugh, W. B.................Ypsilanti
Austin, L. B.................Saginaw, W. S.
Agnew, P. G.................Pontiac
Allison, Clara J.................Hastings
Andruss, W. R.................Grand Rapids
Alley, Sadie M.................Detroit Western

Beman, W. W.................University
Bailey, Susan R.................Port Huron
Bishop, Harriette A.................Detroit Central
Brown, Hugh ....Chicago, Ill
Bronson, C. M.................Toledo, Ohio
Barnard, Anna ....Central Normal
Bole, S. J.................Durand
Buell, Bertha G.................Ypsilanti
Ballard, Edna L.................Owosso
Breed, Gertrude ....Ann Arbor
Burrows, C. W.................Detroit Central
Bemis, C. L.................Ionia
Barbour, F. A.................Normal College
Broesker, R. W.................Standish
Bell, G. W.................Olivet College
Bartlett, A. E.................Detroit
Beddow, I. A.................Olivet College
Bassett, I. A.................Wyandotte
Buck, F. P.................Pontiac
Burt, Amy M.................Mt Pleasant
Brown, A. N.................Mich Agr College
Bolt, A. N.................Otsego
Baker, Ida.................Petoskey
Bishop, J. R.................Detroit Eastern
Burnham, Ernest.................Western Normal
Barber, Carrie A.................Hastings
Bishop, W. R. T.................St Johns
Bradshaw, J. W.................University
Bailey, Benj. F.................University

Cooke, C. S. .... Detroit Central
Crittenden, A. R. .... Olivet College
Curtis, A. E. .... Adrian
Carhart, H. S. .... University
Chamberlain, A. W. .... Hastings
Chute, H. N. .... Ann Arbor
Coburn, W. G. .... Battle Creek
Cody, A. N. .... Flint
Curtis, G. H. .... Gaylord
Curtis, H. L. .... Mich. Agr. College
Comstock, E. H. .... Houghton
Cobb, Anna F. .... Kalamazoo
Cook, Webster .... Saginaw, E. S.
Cleary, P. R. .... Cleary's Business College
Corns, J. H. .... Detroit Western
Churchill, Fred .... Detroit
Clemans, E. A. .... Detroit Central
Carrick, C. H. .... Constantine
Cobb, M. A. .... Lansing
Crane, Mrs. S. A. .... Port Huron
Coddington, E. A. .... Manila, P. I.
Conover, Miss S. G. .... Detroit Central
Currier, Mabel .... Buchanan
Clark, J. E. .... Holland

D'Ooge, Benj. L. .... Normal College
Davis, J. B. .... Detroit Central
Diekhoff, Tobias .... University
Dow, E. W. .... University
Daboll, Winifred C. .... St. Johns
Dudley, S. M. .... Monroe
Doane, H. C. .... Grand Rapids
Dailey, H. C. .... Hudson
Dudley, Caroline .... Hillsdale
De Young, Julia .... Grand Haven

Everett, J. P. .... Adrian
Easton, A. J. .... Port Huron
Essery, E. E. .... Manchester
Ellsworth, F. E. .... Harbor Beach
Elliot, Lucile .... Pontiac
Ewing, J. W. .... Alma College
Ewing, Mrs. J. W. .... Alma

Finney, B. A. .... University Library
Frost, H. H. .... Detroit Central
Fullerton, Fred .... Mason
Frost, J. M. .... Muskegon
Fox, J. E. .... Three Rivers
Frederick, O. G. .... Detroit
Frutig, Marie L. .... Detroit Western

Green, Loa .... Big Rapids
Gallup, E. A. .... Ann Arbor
Gallup, Mrs. E. A. .... Ann Arbor
Garwood, R. S. .... Marshall
Goddard, Mary A. .... Normal College
Goodrich, F. S. .... Albion College
Gass, O. M. .... North Branch
Gold, Mary .... Flint
Gilbert, I. B. .... Traverse City
Grawn, C. T. .... Central Normal
Ginn, Agnes .... Grand Rapids
Green, E. W. .... Albion
Green, Cynthia A. .... Charlotte
Goodfellow, Theodore .... Royal Oak
Gelston, H. M. .... Bay City

Hulst, Caroline S. .... Grand Rapids
Halsey, L. R. .... Chicago, Ill.
Haug, Bernice L. .... Detroit Central
Hawkes, W. H. .... Ann Arbor
Hull, Isabella H. .... Detroit Central
Hull, L. C. .... Mich. Military Academy
Hudson, Richard .... University
Holt, N. P. .... Toledo, Ohio
Hartbeck, Flora H. .... Tecumseh
Hartwell, S. O. .... Kalamazoo
Harris, J. H. .... Pontiac
Hickey, T. P. .... Battle Creek
Hungerford, V. R. .... Decatur
Hawes, Mary F. .... Plymouth
Hochstein, Emilia .... Kalamazoo
Hudson, A. S. .... Chesaning
Harvey, N. A. .... Ypsilanti
Hammond, J. E. .... Lansing
Hood, Herbert .... Bay City
Harper, Miss S. .... Detroit Central
Hornberger, J. J. .... Northville
Hood, Helen .... Detroit Central

Isbell, W. N. .... Plymouth
Irwin, F. C. .... Detroit Central

Jocelyn, L. P. .... Ann Arbor
Jennings, Albert .... Grand Rapids
Jones, L. H. .... Normal College
Jamieson, Clara O. .... Ann Arbor
Josselyn, H. N. .... Detroit Central

Kelsey, F. W. .... University
Keeler, F. W. .... Central Normal

Kirk, R. R. .... Ann Arbor
King, Mrs. S. E. .... Lansing
Kaiser, Grace .... Mt. Clemens

Ludwig, W. A. .... Union City
Lyons, D. F. .... Fenton
Ladd, A. J. .... Ann Arbor
Laird, S. B. .... Normal College
Lewis, W. F. .... Port Huron
Lyman, E. A. .... Normal College
Lightbody, William .... Detroit
Larzelere, C. S. .... Central Normal
Lee, L. B. .... Oak Park, Ill.
Lamb, Ida A. .... Lansing
Longman, M. W. .... Galesburg
Lull, H. G. .... Mt. Clemens
Lautner, J. E. .... Northern Normal
Lawrence, Dean .... Caro
Lyon, Ida .... Port Huron
Liebig, H. A. .... Ann Arbor

Mays, V. G. .... Ann Arbor
Morrill, C. B. .... Ann Arbor
Montgomery, Jabez .... Ann Arbor
Markley, J. L. .... University
Miner, Mary L. .... Detroit Eastern
Marckwardt, O. C. .... Grand Rapids
Marsh, G. E. .... Cleveland, Ohio
Mercer, W. L. .... Buchanan
Morse, W. A. .... Detroit Western
Mann, L. V. .... Port Huron
Milroy, Mina A. .... Detroit
Mills, O. M. .... Hudson
Matthews, J. W. .... Detroit Western
Markham, H. A. .... Marine City
Miller, R. B. .... Memphis
Marsh, E. O. .... Jackson
Munson, J. M. .... Clarkston
Michens, C. W. .... Adrian
Mackenzie, David .... Detroit Central
McElroy, E. M. .... Three Rivers
McMorris, J. F. .... Kalamazoo
McIntosh, J. J. .... Mt. Clemens
McKay, F. B. .... Bad Axe
McLean, C. H. .... Schoolcraft
McClelland, C. C. .... Benton Harbor
McGraw, Kate .... Birmingham

Norton, L. S. .... Jackson
Nutt, H. D. .... Chicago, Ill.

Newcombe, F. C. .... University
Niederpren, Adolph .... Detroit

Olcutt, Amelia F. .... Bessemer

Pearce, W. H. .... Albion
Peet, B. W. .... Normal College
Porter, Alice .... Ann Arbor
Putnam, Daniel .... Normal College
Paine, Lillian W. .... Detroit Central
Palmer, E. D. .... W. Bay City
Patterson, G. W. Jr. .... University
Pettee, Edith E. .... Detroit Eastern
Phelps, Jessie .... Normal College
Parmelee, L. S. .... Flint
Porter, J. E. .... Jackson
Putnam, R. R. .... Detroit Eastern
Perry, C. M. .... Coldwater
Peckham, Miss H. G. .... Hastings
Phelps, Nancy .... Detroit Western

Rebec, George .... University
Richter, L. E. .... Sault Ste. Marie
Randall, H. M. .... University
Ross, De Forest .... Ypsilanti
Root, C. C. .... Shelby
Rivett, B. J. .... Homer
Raymond, Rena B. .... Kalamazoo
Reed, J. O. .... University
Rutledge, Edna .... Buchanan
Roper, Gertrude .... Detroit
Reath, Sarah .... Norway
Riley, T. J. .... Western Normal
Ronan, Bertha M. .... Central Normal

Swain, Geo. R. .... Bay City
Springer, D. W. .... Ann Arbor
Smith, N. F. .... Olivet College
Sage, W. V. .... Mt. Pleasant
Slauson, H. M. .... Ann Arbor
Sloan, N. B. .... Lansing
Snyder, J. L. .... Mich. Agr. College
Stone, J. C. .... Normal College
Strong, E. A. .... Normal College
Stellberger, Lettie V. .... Ionia
Stellwagen, Mary E. .... Wayne
Smith, Florence E. .... Cedar Springs
Sharpe, E. N. .... Bay City
Schweitzer, Louise .... Grand Rapids
Stearns, Frances .... Adrian

Sturgis, Martha .... Ann Arbor
Slayton, Flora .... Grand Rapids
Springman, J. C. .... Ypsilanti
Schmitt, J. J. .... Port Huron
Sawyer, A. R. .... Mich. Agr. College

Taylor, Harriett L. .... Bay City
Turner, A. L. .... Saline
Thalman, J. L. .... Owosso
Temple, A. P. .... Owosso
Taylor, Carrie L. .... Detroit
Tiedgen, F. A. .... Detroit
Volland, A. J. .... Grand Rapids
Verner, Annie .... Hillsdale
Vandenberg, L. H. .... Owosso

Wines, L. D. .... Ann Arbor
Warriner, E. C. .... Saginaw, E. S.
Whedon, Sara .... Ann Arbor
Williams, R. D. .... Chicago
Wilson, E. J. .... Adrian
Wentworth, W. H. .... Fremont
Watkins, E. D. .... Ithica
Whitney, W. L. .... Saginaw, E. S.
Wilcox, F. E. .... Chelsea
Wood, G. L. .... Fairhaven
Winter, O. B. .... Tecumseh
Wheaton, F. W. .... Perry
Waldo, D. B. .... Western Normal
Warne, H. G. .... Newberry
Whitney, A. S. .... University
Williams, Ethel May .... Grand Rapids
Wade, C. J. .... Flint
Wood, L. H. .... Kalamazoo
Washburn, E. R. .... Dexter
Wagner, J. L. .... Grand Ledge
Wright, W. R. .... Benton Harbor

Zedlar, John .... Albion